

DOCUMENT RESUME

ED 479 672

CE 085 379

TITLE Automotive Technologies. State Competency Profile.

INSTITUTION Ohio Board of Regents, Columbus.; Ohio State Dept. of Education, Columbus.; Ohio State Univ., Columbus. Tech Prep Curriculum Services.

PUB DATE 2001-00-00

NOTE 137p.

AVAILABLE FROM For full text: <http://www.ohnpcs.org/cp/automotive.asp>.

PUB TYPE Guides - Non-Classroom (055)

EDRS PRICE EDRS Price MF01/PC06 Plus Postage.

DESCRIPTORS Articulation (Education); Associate Degrees; *Auto Mechanics; *Competency Based Education; Computer Literacy; Education Work Relationship; Electrical Systems; Employment Potential; *Employment Qualifications; Engines; Job Skills; Minimum Competencies; Postsecondary Education; Secondary Education; State Standards; Statewide Planning; *Tech Prep; *Technical Occupations; Technology Education; *Vocational Education

IDENTIFIERS Brakes (Automotive); Career and Technical Education; Industry Based Skill Standards; National Institute Automotive Service Excellence; *Ohio; Steering (Automotive); Transmissions (Automotive)

ABSTRACT

This document, which lists the technical automotive technologies competencies identified by representatives from business, industry, and labor as well as technical educators throughout Ohio, is intended to assist individuals and organizations in developing college tech prep programs that will prepare students from secondary through post-secondary associate degree programs for employment as automotive service technicians. (Automotive service technicians are individuals who apply technical knowledge and skills to diagnose, repair, service, and maintain all types of automotive vehicles.) The technical competencies are listed in the following categories: (1) preparation in all of the eight National Institute for Automotive Service Excellence (ASE) skill areas suspension and steering, brakes, electrical/electronic systems, engine performance, engine repair, heating and air conditioning, automatic transmission and transaxle, and manual drive train and axles for certification by ASE testing; (2) basic computer skills; and (3) ability to work collaboratively with others. The competencies, which are separated into essential competencies needed to ensure a minimal level of employability and recommended competencies, are organized by instructional units and include suggestions as to when students should be introduced to and proficient at them. Includes a list of technical competency profile (TCP) panel members and an automotive TCP matrix. (MO)



U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION
CENTER (ERIC)

☒ This document has been reproduced as
received from the person or organization
originating it.

☐ Minor changes have been made to
improve reproduction quality.

- Points of view or opinions stated in this
document do not necessarily represent
official OERI position or policy.

PERMISSION TO REPRODUCE AND
DISSEMINATE THIS MATERIAL HAS
BEEN GRANTED BY

M. Arins

TO THE EDUCATIONAL RESOURCES
INFORMATION CENTER (ERIC)

1

AUTOMOTIVE TECHNOLOGIES

State Competency Profile

**Tech Prep Curriculum Services
In conjunction with
The Ohio Department of Education
And
The Ohio Board of Regents**

BEST COPY AVAILABLE

Tech Prep Automotive TCP Panel

November 16, 1999 & January 31, 2000

Business, Industry, and Labor Representatives

Bob Dye

Employer, Service Department
Dave White Chevrolet

Bob Evans

Owner/President
Evans Automotive

Randy Griesdorn

Owner/President, Sales/Service Department
C.A.R.S., Inc.

Dan Gross

Owner/Manager
Gross Automotive

Ray Jeffers

Owner
Ray's Service Centers

Mark Moses

Owner
Moses Automotive

Ed Pastorek

Employer, Service Department
Dave White Chevrolet

Lyle Pheils

Manager
Michel Tire Co.

Daniel J. Schatt

President
Schatt's Repair Service, Inc.

Lyn Smith

Owner
Smith & Company

Rich Timbers

Service Manager
Ed Schmidt Pontiac

Mark Traczyk

Operations Director
Mathews Ford

Technical Educator Representatives

Associate Degree Educators

Randall K. Bennett

Dept. Head, Automotive Engineering Tech
Stark State College

Michael Rick Francis

Professor, Transportation Technologies
Owens Community College

John Hatton

Business Technology Instructor
Cincinnati State Technical & Community
College

Keith Mains, Sr.

Program Chair, Automotive Service Mgmt
Cincinnati State Technical & Community
College

Andy O'Neal

Associate Dean, Technology Division
Northwestern College

Andrew A. Rezin

Administrator, Automotive & Applied
Technology
Columbus State Community College

Ronald Roeder

Dean, Technology Division
Northwestern College

Technical Educator Representatives

Secondary Educators

James Anderson

Automotive Technology Instructor
Greenville Senior High School

Robert Anderson

Automotive Technology Instructor
Penta County Vocational School

Glenn Ashenfelter

Automotive Instructor
Penta County Vocational School

Michael B. Bell

Automotive Technology Instructor
Great Oaks Institute of Technology & Career
Development, Laurel Campus

Rick L. Biederman

Senior Automotive Mechanics Instructor
Lima Senior High School

Steve Bowman

Supervisor, T&I
Great Oaks Institute of Technology & Career
Development

Richard Burky

Senior Automotive Technology Instructor
Jackson High School

Jeff Duncan

Automotive Technology Instructor
Vantage Career Center

Ronald Galloway

Junior Automotive Technology Instructor
Clay High School

Leon Hubbard

Automotive Technology Instructor
Great Oaks Institute of Technology & Career
Development, Scarlet Oaks

Robert L. Joseph

Automotive Technology Instructor
Great Oaks Institute of Technology & Career
Development, Scarlet Oaks

Robert J. McCabe

Automotive Technology Instructor
Great Oaks Institute of Technology & Career
Development, Live Oaks

Harry McPherson

Automotive Technology Instructor
Tri Star Career Compact

Charley Overbee

Automotive Technology Instructor
Northwest High School

Gerald Petak

Excel Technology Instructor
Mayfield High School

Robert Posey

Automotive Mechanics Instructor
Choffin Career Center

Joe Rose

Automotive Technology Instructor
Great Oaks Institute of Technology & Career
Development, Diamond

Lynn Roth

Automotive Instructor
Start High School

Dave Seiss

Supervisor, Administrator
Pioneer CTC

Dale R. Sirl

Department Head, Automotive Technology
Instructor
Valley Forge High School

Glenn Smith

Automotive Technology Instructor
Whitmer Vocational School

Richard Strode

Automotive Instructor
Morgan High School

Tech Prep Automotive TCP Releveling Panel

February 13, 2001

Technical Educator Representatives

Associate Degree Educators

Brent Benzie

Instructor, Automotive Engineering
Technologies
Stark State College of Technology

Andrew A. Rezin

Administrator, Automotive & Applied
Technologies
Columbus State Community College

Michael Rick Francis

Professor, Transportation Technologies
Owens Community College

Ronald Roeder

Dean, College of Technology
University of Northwestern Ohio

Secondary Educators

James Anderson

Instructor, Automotive Technologies
Greenville Senior High School

Glenn Smith

Instructor, Automotive Technologies
Whitmer Career and Technology

Harry McPheron

Instructor, Automotive Technologies
Tri Star Career Compact

Richard Strode

Instructor, Automotive Technologies
Morgan High School

DRAFT
Occupational Definition
Automotive Service Technician

An individual who applies technical knowledge and skills to diagnose, repair, service, and maintain all types of automotive vehicles. Technical competencies include, but should not be limited to:

- ? Preparation in all of the following eight ASE skill areas for certification by ASE testing:
 - 1. Suspension and Steering
 - 2. Brakes
 - 3. Electrical/Electronic Systems
 - 4. Engine Performance
 - 5. Engine Repair
 - 6. Heating and Air Conditioning
 - 7. Automatic Transmission and Transaxle
 - 8. Manual Drive Train and Axles
- ? Basic computer skills
- ? Ability to work collaboratively with others

**

LEVELING CODES

**

GRADE LEVEL

12 = by the end of grade 12

AD = by the end of the Associate Degree

DEPTH

I = Introduce (applies to at least three or 25% of the competency builders)

IR = Introduce and Reinforce

R = Reinforce or add depth (after introducing or proficiency)

P = Proficient (achievement of the competency)

PR = Proficient and Reinforce

OTHER (Determined by Business, Industry and Labor Panel)

Essential Competency: Competency is needed to ensure **minimal** level of employability. Entry level employees should be able to perform this competency without supervision. Competencies required for certification, licensure, and/or national skills standards should be tagged as essential.

Recommended Competency: Competency should be included but is not essential for minimal level of employability.

Delete: Competency should not be included.

Example:

BIL: Essential Recommended Delete

	12	AD
EDU	P	R

Competency: XXXXXXXX

Example:

BIL: Essential Recommended Delete

	12	AD
EDU	P	R

Competency: YYYYYYYY

Competency Builders:

SSS

XXX

AUTOMOTIVE TECHNOLOGIES COMPETENCY PROFILE MATRIX

Page	Area	Part One: NATEF Task List by Area
1	1	Engine Repair
4	2	Automatic Transmission and Transaxle
7	3	Manual Drive Train and Axles
10	4	Suspension and Steering
13	5	Brakes
16	6	Heating and Air Conditioning
19	7	Electrical/Electronic Systems
22	8	Engine Performance
Page	Area	Part Two: NATEF Task List by Priority/Area
1	1	Engine Repair
4	2	Automatic Transmission and Transaxle
7	3	Manual Drive Train and Axles
12	4	Suspension and Steering
16	5	Brakes
20	6	Heating and Air Conditioning
24	7	Electrical/Electronic Systems
27	8	Engine Performance
Page	Unit	Part Three: Competency Profile
1	1	Quality Assurance
4	2	Technical Recording and Reporting
6	3	Workplace Safety
10	4	Management and Supervision
17	5	Customer Relations
19	6	Troubleshooting and Repair
23	7	Electrical Theory
27	8	Equipment Maintenance
32	9	Mechanical Power Distribution
41	10	Hydraulics and Pneumatics
49	11	Basic Materials Science

AREA 1: ENGINE REPAIR

For every task in Engine Repair, the following safety requirement must be strictly enforced:

Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.

Task	P	12	AD
A. General Engine Diagnosis; Removal and Reinstallation (R & R)			
1. Verify and interpret engine concern; determine necessary action.	1	IR	PR
2. Inspect engine assembly for fuel, oil, coolant, and other leaks; determine necessary action.	2	P	R
3. Diagnose engine noises and vibrations; determine necessary action.	3	IR	PR
4. Diagnose the cause of excessive oil consumption, unusual engine exhaust color, odor, and sound; determine necessary action.	3	IR	PR
5. Perform engine vacuum tests; determine necessary action.	1	P	
6. Perform cylinder power balance tests; determine necessary action.	1	P	
7. Perform cylinder compression tests; determine necessary action.	1	P	
8. Perform cylinder leakage tests; determine necessary action.	1	P	
9. Remove engine (front-wheel drive); prepare for disassembly.	3	IR	PR
10. Reinstall engine (front-wheel drive).	3	IR	PR
11. Remove engine (rear-wheel drive); prepare for disassembly.	3	IR	PR
12. Reinstall engine (rear-wheel drive).	3	IR	PR
B. Cylinder Head and Valve Train Diagnosis and Repair			
1. Remove cylinder head(s); visually inspect cylinder head(s) for cracks; check gasket surface areas for warpage and leakage; check passage condition.	2	P	R
2. Install cylinder heads and gaskets; tighten according to manufacturer's specifications and procedures.	2	P	R
3. Inspect and test valve springs for squareness, pressure, and free height comparison; replace as needed.	3	I	P
4. Inspect valve spring retainers, locks, and valve grooves.	2	P	PR
5. Replace valve stem seals.	3	IR	PR

Task	P	12	AD
6. Inspect valve guides for wear; check valve guide height and stem-to-guide clearance; recondition or replace as needed.	3	IR	PR
7. Resurface valves; perform necessary action.	2	IR	PR
8. Resurface valve seats; perform necessary action.	2	IR	PR
9. Check valve face-to-seat contact and valve seat concentricity (runout); service seats and valves as needed.	3	IR	PR
10. Check valve spring assembled height and valve stem height; service valve and spring assemblies as needed.	2	IR	PR
11. Inspect pushrods, rocker arms, rocker arm pivots and shafts for wear, bending, cracks, looseness, and blocked oil passages (orifices); perform necessary action.	2	IR	PR
12. Inspect hydraulic or mechanical lifters; replace as needed.	2	IR	PR
13. Adjust valves (mechanical or hydraulic lifters).	1	P	
14. Inspect camshaft drives (including gear wear and backlash, sprocket and chain wear); replace as necessary.	2	IR	PR
15. Inspect and replace timing belt(s), overhead camdrive sprockets, and tensioners; check belt tension; adjust as necessary.	1	P	
16. Inspect camshaft for runout, journal wear and lobe wear.	3	IR	PR
17. Inspect and measure camshaft bearing for wear, damage, out-of-round, and alignment; determine necessary action.	3	IR	PR
18. Verify camshaft(s) timing according to manufacturer's specifications and procedure.	1	P	
C. Engine Block Assembly Diagnosis and Repair			
1. Inspect and replace pans, covers, gaskets, and seals.	2	P	PR
2. Inspect engine block for visible cracks, passage condition, core and gallery plug condition, and surface warpage; determine necessary action.	2	P	PR
3. Inspect internal and external threads; restore as needed (includes installing thread inserts).	1	P	
4. Remove cylinder wall ridges.	3	P	R
5. Inspect and measure cylinder walls for damage and wear; determine necessary action.	2	IR	PR
6. Deglaze and clean cylinder walls.	1	P	
7. Inspect and measure camshaft bearings for wear, damage, out-of-round, and alignment; determine necessary action.	3	IR	PR
8. Inspect crankshaft for surface cracks and journal damage; check oil passage condition; measure journal wear; determine necessary action.	3	IR	PR
9. Inspect and measure main and connecting rod bearings for damage, clearance, and end play; determine necessary action (includes the proper selection of bearings).	2	IR	PR
10. Identify piston and bearing wear patterns that indicate connecting rod alignment and main bearing bore problems; inspect rod alignment and bearing bore condition.	3	IR	PR
11. Inspect, measure, and service pistons and pins; determine	2	IR	PR

Task	P	12	AD
necessary action.			
12. Inspect, measure, and install piston rings.	2	IR	PR
13. Inspect, repair or replace crankshaft vibration damper (harmonic balancer).	3	P	PR
14. Reassemble engine components using correct gaskets and sealants.	2	P	R
15. Inspect auxiliary (balance, intermediate, idler, counterbalance or silencer) shaft(s); inspect shaft(s) and support bearing for damage and wear; determine necessary action; reinstall and time.	3	I	P
16. Prime engine lubrication system.	1	IR	PR
D. Lubrication and Cooling Systems Diagnosis and Repair			
1. Perform oil pressure tests; determine necessary action.	1	P	
2. Inspect oil pump gears or rotors, housing, pressure relief devices, and pump drive; perform necessary action.	3	IR	PR
3. Perform cooling system, cap, and recovery system tests (pressure, combustion leakage, and temperature); determine necessary action.	1	P	
4. Inspect, replace, and adjust drive belts, tensioners, and pulleys.	1	P	
5. Inspect and replace engine cooling and heater system hoses.	2	P	PR
6. Inspect, test, and replace thermostat and housing.	2	P	PR
7. Test coolant; drain and recover coolant; flush and refill cooling system with recommended coolant; bleed air as required.	1	P	
8. Inspect, test, remove, and replace water pump.	2	IR	PR
9. Remove and replace radiator.	2	IR	PR
10. Inspect, and test fan(s) (electrical or mechanical), fan clutch, fan shroud, and air dams.	2	IR	PR
11. Inspect auxiliary oil coolers; replace as needed.	3	P	PR
12. Inspect, test, and replace oil temperature and pressure switches and sensors.	2	IR	PR
13. Perform oil and filter change.	1	P	

AREA 2: AUTOMATIC TRANSMISSION AND TRANSAXLE

For every task in Automatic Transmission and Transaxle, the following safety requirement must be strictly enforced:

Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.

Task	P	12	AD
A. General Transmission and Transaxle Diagnosis			
1. Identify and interpret transmission concern; assure proper engine operation; determine necessary action.	1	I	P
2. Diagnose unusual fluid usage, level, and condition concerns; determine necessary action.	1	I	P
3. Perform pressure tests; determine necessary action.	1		P
4. Perform lock-up converter system tests; determine necessary action.	2		P
5. Diagnose electronic, mechanical, hydraulic, vacuum control system concerns; determine necessary action.	1	I	P
6. Diagnose noise and vibration concerns; determine necessary action.	3		P
B. Transmission and Transaxle Maintenance and Adjustment			
1. Inspect, adjust or replace throttle (TV) linkages or cables, check gear select indicator (as applicable).	1	IR	PR
2. Service transmission; perform visual inspection; replace fluids and filters.	1	IR	PR
C. In-Vehicle Transmission and Transaxle Repair			
1. Inspect, adjust or replace (as applicable) vacuum modulator; inspect and repair or replace lines and hoses.	3	IR	P
2. Inspect, repair, and replace governor assembly.	3	I	P
3. Inspect and replace external seals and gaskets.	2	I	P
4. Inspect extension housing, bushings and seals; perform necessary action.	3	IR	P
5. Inspect, leak test, flush, and replace cooler, lines, and fittings.	1	I	P
6. Inspect and replace speedometer drive gear, driven gear, vehicle speed sensor (VSS), and retainers.	3	IR	P
7. Inspect and test, adjust, repair or replace transmission related electrical and electronic components (includes computers, solenoids, sensors, relays, switches, and harnesses).	1	I	P
8. Inspect, replace, and align powertrain mounts.	3	P	PR

Task	P	12	AD
D. Off-Vehicle Transmission and Transaxle Repair			
1. Removal, Disassembly, and Reinstallation			
1. Remove and reinstall transmission and torque converter (rear-wheel drive).	2	IR	P
2. Remove and reinstall transaxle and torque converter assembly.	2	IR	P
3. Disassemble, clean, and inspect transmission/transaxle.	1		P
4. Inspect, measure, clean, and replace valve body (includes surfaces and bores, springs, valves, sleeves, retainers, brackets, check-balls, screens, spacers, and gaskets), and torque valve body bolts.	2		P
5. Inspect servo bore, piston, seals, pin, spring, and retainers; determine necessary action.	3		P
6. Inspect accumulator bore, piston, seals, spring, and retainer; determine necessary action.	3		P
7. Assemble transmission/transaxle.	1		P
2. Oil Pump and Converter			
1. Inspect converter flex plate, attaching parts, pilot, pump drive, and seal areas.	2	IR	P
2. Measure torque converter endplay and check for interference; check stator clutch.	2		P
3. Inspect, measure, and replace oil pump assembly and components.	3		P
4. Check torque converter and transmission cooling system for contamination.	1		P
3. Gear Train, Shafts, Bushings and Case			
1. Measure endplay or preload; determine necessary action.	1		P
2. Inspect, measure, and replace thrust washers and bearings.	2		P
3. Inspect oil delivery seal rings, ring grooves, and sealing surface areas.	2		P
4. Inspect bushings; replace as needed.	2		P
5. Inspect and measure planetary gear assembly (includes sun, ring gear, thrust washers, planetary gears, and carrier assembly); replace as needed.	2		P
6. Inspect case bores, passages, bushings, vents, and mating surfaces; determine necessary action.	2		P
7. Inspect transaxle drive, link chains, sprockets, gears, bearings, and bushings; perform necessary action.	2		P
8. Inspect, measure, repair, adjust or replace transaxle final drive components.	2		P
9. Inspect and reinstall parking pawl, shaft, spring, and retainer; determine necessary action.	3		P
4. Friction and Reaction Units			
1. Inspect clutch drum, piston, check-balls, springs, retainers, seals, and friction and pressure plates; replace as needed.	2		P
2. Measure clutch pack clearance; adjust as needed.	1		P
3. Air test operation of clutch and servo assemblies.	1		P

Task	P	12	AD
4. Inspect roller and sprag clutch, races, rollers, sprags, springs, cages, and retainers; replace as needed.	2		P
5. Inspect bands and drums; adjust or replace as needed.	3		P

AREA 3: MANUAL DRIVE TRAIN AND AXLES

For every task in Manual Drive Train and Axles, the following safety requirement must be strictly enforced:

Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.

Task	P	12	AD
A. Clutch Diagnosis and Repair			
1. Diagnose clutch noise, binding, slippage, pulsation, and chatter; determine necessary action.	1	I	P
2. Inspect clutch pedal linkage, cables, automatic adjuster mechanisms, brackets, bushings, pivots, and springs; perform necessary action.	1	I	P
3. Inspect hydraulic clutch slave and master cylinders, lines, and hoses; perform necessary action.	1	I	P
4. Inspect release (throw-out) bearing, lever, and pivot; perform necessary action.	1	I	P
5. Inspect and replace clutch pressure plate assembly and clutch disc.	1	IR	P
6. Inspect, remove or replace crankshaft pilot bearing or bushing (as applicable).	1	IR	P
7. Inspect flywheel and ring gear for wear and cracks, measure runout; determine necessary action.	1	IR	P
8. Inspect engine block, clutch (bell) housing, and transmission/transaxle case mating surfaces; determine necessary action.	3	IR	PR
9. Measure flywheel-to-block runout and crankshaft endplay; determine necessary action.	3	IR	PR
B. Transmission/Transaxle Diagnosis and Repair			
1. Remove and reinstall transmission/transaxle.	2	IR	PR
2. Disassemble, clean, and reassemble transmission/transaxle components.	2	I	PR
3. Inspect transmission/transaxle case, extension housing, case mating surfaces, bores, bushings, and vents; perform necessary action.	3		P
4. Diagnose noise, hard shifting, jumping out of gear, and fluid leakage concerns; determine necessary action.	3	I	PR
5. Inspect, adjust, and reinstall shift linkages, brackets, bushings, cables, pivots, and levers.	3	IR	PR
6. Inspect and reinstall powertrain mounts.	3	P	PR
7. Inspect and replace gaskets, seals, and sealants; inspect sealing	2	IR	PR

Task	P	12	AD
surfaces.			
8. Remove and replace transaxle final drive.	3	I	PR
9. Inspect, adjust, and reinstall shift cover, forks, levers, grommets, shafts, sleeves, detent mechanism, interlocks, and springs.	2	I	PR
10. Measure endplay or preload (shim or spacer selection procedure) on transmission/transaxle shafts; perform necessary action.	1		P
11. Inspect and reinstall synchronizer hub, sleeve, keys (inserts), springs, and blocking rings.	2	I	PR
12. Inspect and reinstall speedometer drive gear, driven gear, vehicle speed sensor (VSS), and retainers.	2	IR	PR
13. Diagnose transaxle final drive assembly noise and vibration concerns; determine necessary action.	3		P
14. Remove, inspect, measure, adjust, and reinstall transaxle final drive pinion gears (spiders), shaft, side gears, side bearings, thrust washers, and case assembly.	2	I	PR
15. Inspect lubrication devices (oil pump or slingers); perform necessary action.	3		P
16. Inspect, test, and replace transmission/transaxle sensors and switches.	1	I	P
C. Drive Shaft and Half Shaft, Universal and Constant-Velocity (CV) Joint Diagnosis and Repair			
1. Diagnose constant-velocity (CV) joint noise and vibration concerns; determine necessary action.	2	IR	PR
2. Diagnose universal joint noise and vibration concerns; perform necessary action.	2	IR	PR
3. Replace front wheel drive (FWD) front wheel bearing.	2	I	PR
4. Inspect, service, and replace shafts, yokes, boots, and CV joints.	1	P	PR
5. Inspect, service, and replace shaft center support bearings.	3	IR	P
6. Check shaft balance; measure shaft runout; measure and adjust driveline angles.	3	I	P
D. Drive Axle Diagnosis and Repair			
1. Ring and Pinion Gears and Differential Case Assembly			
1. Diagnose noise and vibration concerns; determine necessary action.	2	I	PR
2. Diagnose fluid leakage concerns; determine necessary action.	2	IR	PR
3. Inspect and replace companion flange and pinion seal; measure companion flange runout.	2	I	PR
4. Inspect ring gear and measure runout; determine necessary action.	2	I	PR
5. Remove, inspect, and reinstall drive pinion and ring gear, spacers, sleeves, and bearings.	2	I	PR
6. Measure and adjust drive pinion depth.	2	I	PR
7. Measure and adjust drive pinion bearing preload.	1	I	P

Task	P	12	AD
8. Measure and adjust side bearing preload and ring and pinion gear total backlash and backlash variation on a differential carrier assembly (threaded cup or shim types).	2	I	PR
9. Check ring and pinion tooth contact patterns; perform necessary action.	1	I	P
10. Disassemble, inspect, measure, and adjust or replace differential pinion gears (spiders), shaft side gears, side bearings, thrust washers, and case.	2	I	PR
11. Reassemble and reinstall differential case assembly; measure runout; determine necessary action.	2	I	PR
2. Limited Slip Differential			
1. Diagnose noise, slippage, and chatter concerns; determine necessary action.	3	I	PR
2. Inspect and flush differential housing; refill with correct lubricant.	2	P	PR
3. Inspect and reinstall clutch (cone or plate) components.	3		P
4. Measure rotating torque; determine necessary action.	3		P
3. Drive Axle Shaft			
1. Diagnose drive axle shafts, bearings, and seals for noise, vibration, and fluid leakage concerns; determine necessary action.	2	I	PR
2. Inspect and replace drive axle shaft wheel studs.	3	P	PR
3. Remove and replace drive axle shafts.	1	P	PR
4. Inspect and replace drive axle shaft seals, bearings, and retainers.	2	I	PR
5. Measure drive axle flange runout and shaft endplay; determine necessary action.	2	I	PR
E. Four-wheel Drive/All-wheel Drive Component Diagnosis and Repair			
1. Diagnose noise, vibration, and unusual steering concerns; determine necessary action.	3		P
2. Inspect, adjust, and repair shifting controls (mechanical, electrical, and vacuum), bushings, mounts, levers, and brackets.	3		P
3. Remove and reinstall transfer case.	3		P
4. Disassemble, service, and reassemble transfer case and components.	3		P
5. Inspect front-wheel bearings and locking hubs; perform necessary action.	3		P
6. Check drive assembly seals and vents; check lube level.	3	IR	PR
7. Diagnose test, adjust, and replace electrical/electronic components of four-wheel drive systems.	3		P

AREA 4: SUSPENSION AND STEERING

For every task in Suspension and Steering, the following safety requirement must be strictly enforced:

Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.

Task	P	I2	AD
A. Steering Systems Diagnosis and Repair			
1. Disable and enable supplemental restraint system (SRS) in accordance with manufacturer's procedures.	1	I	PR
2. Remove and replace steering wheel; center/time supplemental restraint system (SRS) coil in accordance with manufacturer's procedures.	1	I	P
3. Diagnose steering column noises, looseness, and binding concerns (including tilt mechanisms); determine necessary action.	3	IR	PR
4. Diagnose power steering gear (non-rack and pinion) binding, uneven turning effort, looseness, hard steering, and fluid leakage concerns; determine necessary action.	3	IR	PR
5. Diagnose power steering gear (rack and pinion) binding, uneven turning effort, looseness, hard steering, and fluid leakage concerns; determine necessary action.	3	IR	PR
6. Inspect steering shaft universal-joint(s), flexible coupling(s), collapsible column, lock cylinder mechanism, and steering wheel; perform necessary action.	2	IR	PR
7. Adjust manual or power non-rack and pinion worm bearing preload and sector lash.	3	I	P
8. Remove and replace manual or power rack and pinion steering gear; inspect mounting bushings and brackets.	2	P	
9. Disassemble, inspect, perform necessary action and reassemble rack and pinion steering gear.	3	I	R
10. Adjust manual or power rack and pinion steering gear.	3	I	
11. Inspect and replace manual or power rack and pinion steering gear inner tie rod ends (sockets) and bellows boots.	2	P	
12. Inspect power steering fluid levels and condition.	1	P	
13. Flush, fill, and bleed power steering system.	2	P	R
14. Diagnose power steering fluid leakage; determine necessary action.	2	P	
15. Remove, inspect, replace, and adjust power steering pump belt.	1	P	
16. Remove, inspect, and replace power steering pump, mounts, seals, and gaskets.	3	P	PR

Task	P	12	AD
17. Remove, inspect, and replace power steering pump pulley; check alignment.	3	P	R
18. Inspect and replace power steering hoses and fittings.	2	P	
19. Inspect and replace pitman arm, relay (centerlink/intermediate) rod, idler arm and mountings, and steering linkage damper.	3	P	R
20. Inspect, replace, and adjust tie rod ends (sockets), tie rod sleeves, and clamps.	2	P	
21. Diagnose and adjust components of electronically controlled steering systems; determine necessary action.	3	I	P
B. Suspension Systems Diagnosis and Repair			
1. Front Suspension			
1. Diagnose short and long arm suspension system noises, body sway, and uneven riding height concerns; determine necessary action.	1	I	P
2. Diagnose MacPherson strut suspension system noises, body sway, and uneven riding height concerns; determine necessary action.	1	I	P
3. Remove, inspect, and install upper and lower control arms, bushings, shafts, and rebound bumpers.	2	P	
4. Remove, inspect, install, and adjust strut (compression/tension) rods and bushings.	2	P	
5. Remove, inspect, and install upper and lower ball joints on short and long arm suspension systems.	2	P	
6. Remove, inspect, and install steering knuckle assemblies.	2	P	
7. Remove, inspect, and install short and long arm suspension system coil springs and spring insulators.	2	P	
8. Remove, inspect, install, and adjust suspension system torsion bars; inspect mounts.	3	P	R
9. Remove, inspect, and install stabilizer bar bushings, brackets, and links.	3	P	R
10. Remove, inspect, and install MacPherson strut cartridge or assembly, strut coil spring, insulators (silencers), and upper strut bearing mount.	1	P	
11. Lubricate suspension and steering systems.	2	P	
2. Rear Suspension			
1. Remove, inspect, and install coil springs and spring insulators.	2	P	
2. Remove, inspect, and install transverse links, control arms, bushings, and mounts.	2	P	
3. Remove, inspect, and install leaf springs, leaf spring insulators (silencers), shackles, brackets, bushings, and mounts.	3	P	R
4. Remove, inspect, and install MacPherson strut cartridge or assembly, strut coil spring, and insulators (silencers).	2	P	

Task	P	12	AD
3. Miscellaneous Service			
1. Inspect, remove, and replace shock absorbers.	1	P	
2. Remove, inspect, and service or replace front and rear wheel bearings.	1	P	
3. Diagnose, inspect, adjust, repair or replace components of electronically controlled suspension systems.	2	I	P
C. Wheel Alignment Diagnosis, Adjustment, and Repair			
1. Diagnose vehicle wander, drift, pull, hard steering, bump steer, memory steer, torque steer, and steering return concerns; determine necessary action.	1	I	P
2. Perform prealignment inspection; perform necessary action.	1	P	R
3. Measure vehicle riding height; determine necessary action.	1	P	R
4. Check and adjust front and rear wheel camber; perform necessary action.	1	P	R
5. Check and adjust caster; perform necessary action.	1	P	R
6. Check and adjust front wheel toe; adjust as needed.	1	P	R
7. Center steering wheel.	1	P	R
8. Check toe-out-on-turns (turning radius); determine necessary action.	2	IR	PR
9. Check SAI (steering axis inclination) and included angle; determine necessary action.	2	IR	PR
10. Check and adjust rear wheel toe.	2	IR	PR
11. Check rear wheel thrust angle; determine necessary action.	2	IR	PR
12. Check for front wheel setback; determine necessary action.	2	IR	PR
13. Check front cradle (subframe) alignment; determine necessary action.	3	P	R
D. Wheel and Tire Diagnosis and Repair			
1. Diagnose tire wear patterns; determine necessary action.	1	P	
2. Inspect tires; check and adjust air pressure.	1	P	
3. Diagnose wheel/tire vibration, shimmy, and noise; determine necessary action.	2	P	
4. Rotate tires according to manufacturer's recommendations.	1	P	
5. Measure wheel, tire, axle, and hub runout; determine necessary action.	2	P	
6. Diagnose tire pull (lead) problem; determine necessary action.	2	P	
7. Balance wheel and tire assembly (static and dynamic).	1	P	
8. Dismount, inspect, repair, and remount tire on wheel.	2	P	
9. Reinstall wheel; torque lug nuts.	1	P	

AREA 5: BRAKES

For every task in Brakes, the following safety requirement must be strictly enforced:

Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.

Task	P	12	AD
A. Hydraulic System Diagnosis and Repair			
1. Measure and adjust pedal height.	2	P	
2. Check master cylinder for internal and external leaks and proper operation; determine necessary action.	2	P	
3. Remove, bench bleed, and reinstall master cylinder.	1	P	
4. Diagnose poor stopping, pulling or dragging concerns caused by problems in the hydraulic system; determine necessary action.	1	P	
5. Inspect brake lines, flexible hoses, and fittings for leaks, dents, kinks, rust, cracks, bulging or wear; tighten loose fittings and supports; determine necessary action.	2	P	
6. Fabricate and install brake lines (double flare and ISO types); replace hoses, fittings, and supports as needed.	2	P	
7. Select, handle, store, and install brake fluids to proper level.	1	P	
8. Inspect, test, and replace metering (hold-off), proportioning (balance), pressure differential, and combination valves.	3	P	R
9. Inspect, test, replace, and adjust height (load) sensing proportioning valve.	3	IR	PR
10. Inspect, test, and replace components of brake warning light system.	3	P	R
11. Bleed (manual, pressure, vacuum or surge) brake system.	1	P	
12. Flush hydraulic system.	3	P	
B. Drum Brake Diagnosis and Repair			
1. Diagnose poor stopping, noise, pulling, grabbing, dragging or pedal pulsation concerns; determine necessary action.	1	P	
2. Remove, clean (using proper safety procedures), inspect, and measure brake drums; service or replace as needed.	1	P	
3. Mount brake drum on lathe; machine braking surface.	2	P	
4. Remove, clean, and inspect brake shoes, springs, pins, clips, levers, adjusters/self-adjusters, other related brake hardware, and backing support plates; lubricate and reassemble.	2	P	
5. Remove, Inspect, and install wheel cylinders.	2	P	
6. Pre-adjust brake shoes and parking brake before installing brake drums or drum/hub assemblies and wheel bearings.	1	P	
7. Install wheel, torque lug nuts, and make final checks and adjustments.	1	P	

Task	P	12	AD
C. Disc Brake Diagnosis and Repair			
1. Diagnose poor stopping, noise, pulsing, grabbing, dragging or pedal pulsation concerns; determine necessary action.	1	P	
2. Remove caliper assembly from mountings; clean and inspect for leaks and damage to caliper housing; determine necessary action.	1	P	
3. Clean and inspect caliper mounting and slides for wear and damage; determine necessary action.	1	P	
4. Remove, clean, and inspect pads and retaining hardware; determine necessary action.	1	P	
5. Disassemble and clean caliper assembly; inspect parts for wear, rust, scoring, and damage; replace seal, boot, and damaged or worn parts.	1	P	
6. Reassemble, lubricate, and reinstall caliper, pads, and related hardware; seat pads, and inspect for leaks.	1	P	
7. Clean, inspect, and measure rotor with a dial indicator and a micrometer; follow manufacturer's recommendations in determining need to machine or replace.	1	P	
8. Refinish rotor according to manufacturer's recommendations.	1	P	
9. Adjust calipers with integrated parking brake system.	3	P	PR
10. Install wheel, torque lug nuts, and make final checks and adjustments.	1	P	
11. Remove and replace rotor.	2	P	
D. Power Assist Units Diagnosis and Repair			
1. Test pedal free travel with and without engine running; check power assist operation.	2	P	PR
2. Check vacuum supply (manifold or auxiliary pump) to vacuum-type power booster.	2	P	
3. Inspect the vacuum-type power booster unit for vacuum leaks; inspect the check valve for proper operation; determine necessary action.	2	P	
4. Inspect and test hydro-boost system and accumulator for leaks and proper operation; determine necessary action.	3	P	R
E. Miscellaneous (Wheel Bearings, Parking Brakes, Electrical, Etc.) Diagnosis and Repair			
1. Diagnose wheel bearing noises, wheel shimmy, and vibration concerns; determine necessary action.	1	P	
2. Remove, clean, inspect, repack, and install wheel bearings and replace seals; install hub and adjust wheel bearings.	1	P	
3. Check parking brake cables and components for wear, rusting, binding, and corrosion; clean, lubricate, and replace as needed.	2	P	
4. Check parking brake operation; adjust as needed.	1	P	
5. Check operation of parking brake indicator light system.	3	P	

Task	P	12	AD
6. Check operation of brake stop light system; adjust and service as needed.	1	P	
7. Replace wheel bearing and race.	1	P	
F. Anti-lock Brake System			
1. Inspect and test anti-lock brake system (ABS) components; determine necessary action.	2	I	P
2. Diagnose poor stopping, wheel lock-up, abnormal pedal feel or pulsation, and noise concerns caused by the anti-lock brake system (ABS); determine necessary action.	2	I	P
3. Diagnose anti-lock brake system (ABS) electronic control(s) and components using self-diagnosis and/or recommended test equipment; determine necessary action.	1	P	
4. Depressurize high-pressure components of the anti-lock brake system (ABS).	2	P	R
5. Bleed the anti-lock brake system's (ABS) front and rear hydraulic circuits.	2	I	P
6. Remove and install anti-lock brake system (ABS) electrical/electronic and hydraulic components.	3	I	P
7. Service, test, and adjust anti-lock brake system (ABS) speed sensors.	2	IR	PR
8. Diagnose anti-lock brake system (ABS) braking concerns caused by vehicle modifications (tire size, curb height, final drive ratio, etc.).	3	I	P

AREA 6: ELECTRICAL/ELECTRONIC SYSTEMS

For every task in Electrical/Electronic Systems, the following safety requirement must be strictly enforced:

Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.

Task	P	12	AD
A. General Electrical System Diagnosis			
1. Use wiring diagrams during diagnosis of electrical circuit problems.	1	P	
2. Check electrical circuits with a test light; determine necessary action.	2	P	R
3. Check voltage and voltage drop in electrical/electronic circuits using a digital multimeter (DMM); determine necessary action.	1	P	
4. Check current flow in electrical/electronic circuits and components using an ammeter; determine necessary action.	1	P	
5. Check continuity and resistances in electrical/electronic circuits and components with an ohmmeter; determine necessary action.	1	P	
6. Check electrical circuits using jumper wires; determine necessary action.	2	P	R
7. Locate shorts, grounds, opens, and resistance problems in electrical/electronic circuits; determine necessary action.	1	P	
8. Measure and diagnose the cause(s) of abnormal key-off battery drain; determine necessary action.	1	P	
9. Inspect and test fusible links, circuit breakers, and fuses; determine necessary action.	1	P	
10. Inspect and test switches, connectors, relays, and wires of electrical/electronic circuits; perform necessary action.	1	P	
11. Repair wiring harnesses and connectors.	1	P	
12. Perform solder repair of electrical wiring.	1	P	
B. Battery Diagnosis and Service			
1. Perform battery state-of-charge test; determine needed service.	1	P	
2. Perform battery capacity test; determine needed service.	1	P	
3. Maintain or restore electronic memory functions.	2	P	R
4. Inspect, clean, fill, and replace battery.	2	P	PR
5. Perform slow/fast battery charge.	2	P	PR
6. Inspect and clean battery cables, connectors, clamps, and hold-downs; repair or replace as needed.	1	P	
7. Start a vehicle using jumper cables and a battery or auxiliary power supply according to manufacturers recommended specifications.	1	P	

Task	P	12	AD
C. Starting System Diagnosis and Repair			
1. Perform starter current draw tests; determine necessary action.	1	P	
2. Perform starter circuit voltage drop tests; determine necessary action.	1	P	
3. Inspect and test starter relays and solenoids; replace as needed.	2	IR	PR
4. Remove and install starter.	2	P	
5. Perform starter bench tests; determine necessary action.	3	IR	PR
6. Inspect and test switches, connectors, and wires of starter control circuits; perform necessary action.	2	P	R
7. Disassemble, clean, inspect, and test starter components; replace as needed.	3	IR	PR
D. Charging System Diagnosis and Repair			
1. Perform charging system output test; determine necessary action.	1	P	
2. Diagnose charging system for the cause of undercharge, no-charge, and overcharge conditions.	1	P	
3. Inspect and adjust generator (alternator) drive belts; replace as needed.	1	P	
4. Inspect and test voltage regulator/regulating circuit; perform necessary action.	2	P	R
5. Remove inspect, and install generator (alternator).	2	P	PR
6. Disassemble generator (alternator), clean, inspect, and test components; determine necessary action.	3	IR	PR
7. Perform charging circuit voltage drop tests; determine necessary action.	1	P	
E. Lighting Systems Diagnosis and Repair			
1. Diagnose the cause of brighter than normal, intermittent, dim, or no light operation; determine necessary action.	2	P	PR
2. Inspect, replace, and aim headlights and bulbs.	2	P	
3. Inspect and diagnose incorrect turn signal or hazard light operation; perform necessary action.	2	P	PR
F. Gauges, Warning Devices, and Driver Information Systems Diagnosis and Repair			
1. Inspect and test gauges and gauge sending units for cause of intermittent, high, low, or no gauge readings; determine necessary action.	2	I	P
2. Inspect and test connectors, wires, and printed circuit boards of gauge circuits; determine necessary action.	3	I	P
3. Diagnose the cause of incorrect operation of warning devices and other driver information systems; determine necessary action.	1	P	
4. Inspect and test sensors, connectors, and wires of electronic instrument circuits; determine necessary action.	3	I	P

Task	P	12	AD
G. Horn and Wiper/Washer Diagnosis and Repair			
1. Diagnose incorrect horn operation; perform necessary action.	3	P	R
2. Diagnose incorrect wiper operation; diagnose wiper speed control and park problems; perform necessary action.	3	IR	PR
3. Diagnose incorrect windshield washer operation; perform necessary action.	3	P	PR
H. Accessories Diagnosis and Repair			
1. Diagnose incorrect operation of motor-driven accessory circuits; determine necessary action.	2	I	P
2. Diagnose incorrect heated glass operation; determine necessary action.	3	P	PR
3. Diagnose incorrect electric lock operation; determine necessary action.	3	IR	PR
4. Diagnose incorrect operation of cruise control systems; repair as needed.	3	IR	PR
5. Diagnose supplemental restraint system (SRS) concerns; determine necessary action. (Note: Follow manufacturer's safety procedures to prevent accidental deployment.)	2	I	PR
6. Diagnose radio static and weak, intermittent, or no radio reception; determine necessary action.	3	I	P

AREA 7: HEATING AND AIR CONDITIONING

For every task in Heating and Air Conditioning, the following safety requirement must be strictly enforced:

Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.

Task	P	12	AD
A. A/C System Diagnosis and Repair			
1. Diagnose unusual operating noises in the A/C system; determine necessary action.	2	I	PR
2. Identify refrigerant type; conduct a performance test of the A/C system; determine necessary action.	1	P	R
3. Leak test A/C system; determine necessary action.	1	P	R
4. Inspect the condition of discharged oil; determine necessary action.	2	I	P
5. Select oil type; measure, and add oil to the A/C system as needed.	2	P	PR
B. Refrigeration System Component Diagnosis and Repair			
1. Compressor and Clutch			
1. Diagnose A/C system conditions that cause the protection devices (pressure, thermal, and PCM) to interrupt system operation; determine necessary action.	2	I	P
2. Inspect A/C compressor drive belts; replace and adjust as needed.	2	P	R
3. Inspect, test, and replace A/C compressor clutch components or assembly.	2	P	R
4. Remove and replace A/C compressor and mountings.	2	P	R
2. Evaporator, Condenser, and Related Components			
1. Determine need for A/C system filter; perform necessary action.	3	P	PR
2. Remove and inspect A/C system mufflers, hoses, lines, fittings, o-rings, seals, and service valves; perform necessary action.	2	P	R
3. Inspect A/C condenser for airflow restrictions; perform necessary action.	1	P	R
4. Remove and install receiver/drier or accumulator/drier.	2	P	R
5. Remove and install expansion valve or orifice (expansion) tube.	2	P	R
6. Inspect evaporator housing water drain; perform necessary action.	3	P	R

Task	P	12	AD
C. Heating, Ventilation, and Engine Cooling Systems Diagnosis and Repair			
1. Diagnose temperature control problems in the heater/ventilation system; determine necessary action.	2	IR	PR
2. Perform cooling system, cap, and recovery system tests (pressure, combustion leakage, and temperature); determine necessary action.	1	P	
3. Inspect engine cooling and heater system hoses and belts; perform necessary action.	1	P	
4. Inspect, test, and replace thermostat and housing.	1	P	
5. Determine coolant condition; drain and recover coolant.	1	P	
6. Flush system; refill system with recommended coolant; bleed system.	1	P	
7. Inspect and test fan, fan clutch (electrical and mechanical), fan shroud, and air dams; perform necessary action.	1	P	PR
8. Inspect and test electrical fan control system and circuits.	1	IR	PR
9. Inspect and test heater control valve(s); perform necessary action.	2	P	R
D. Operating Systems and Related Controls Diagnosis and Repair			
1. Diagnose failures in the electrical controls of heating, ventilation, and A/C (HVAC) systems; determine necessary action.	2	IR	PR
2. Inspect and test A/C-heater blower, motors, resistors, switches, relays, wiring, and protection devices; perform necessary action.	2	IR	PR
3. Test A/C compressor load cut-off systems; determine necessary action.	3	I	P
4. Diagnose failures in the vacuum and mechanical components and controls of the heating, ventilation, and A/C (HVAC) system; determine necessary action.	2	IR	PR
5. Inspect and test A/C-heater control panel assembly; determine necessary action.	3	IR	PR

Task	P	12	AD
6. Inspect and test A/C-heater control cables and linkages; perform necessary action.	3	IR	PR
7. Inspect and test A/C-heater ducts, doors, hoses, and outlets; perform necessary action.	3	IR	PR
8. Check operation of automatic and semi-automatic heating, ventilation, and air-conditioning (HVAC) control systems; determine necessary action.	3	I	IR
E. Refrigerant Recovery, Recycling, and Handling			
1. Verify correct operation and maintenance of refrigerant handling equipment.	1	P	
2. Identify (by label application or use of a refrigerant identifier) and recover A/C system refrigerant.	1	P	
3. Recycle refrigerant.	1	P	
4. Label and store refrigerant.	1	P	
5. Test recycled refrigerant for non-condensable gases.	1	P	
6. Evacuate and charge A/C system.	1	P	

AREA 8: ENGINE PERFORMANCE

For every task in Engine Performance, the following safety requirement must be strictly enforced:

Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.

Task	P	12	AD
A. General Engine Diagnosis			
1. Interpret and verify concern; determine necessary action.	1	I	P
2. Inspect engine assembly for fuel, oil, coolant, and other leaks; determine necessary action.	2	P	R
3. Diagnose unusual engine noise or vibration concerns; determine necessary action.	2	I	P
4. Diagnose unusual exhaust color, odor, and sound; determine necessary action.	2	P	PR
5. Perform engine absolute (vacuum/boost) manifold pressure tests; determine necessary action.	1	P	R
6. Perform cylinder power balance test; determine necessary action.	1	P	
7. Perform cylinder compression test; determine necessary action.	1	P	
8. Perform cylinder leakage test; determine necessary action.	1	P	
9. Diagnose engine mechanical, electrical, electronic, fuel, and ignition concerns with an oscilloscope and engine diagnostic equipment; determine necessary action.	1	I	P
10. Prepare 4 or 5 gas analyzer; inspect and prepare vehicle for test, and obtain exhaust readings; interpret readings, and determine necessary action.	1	I	P

Task	P	12	AD
B. Computerized Engine Controls Diagnosis and Repair			
1. Retrieve and record stored OBD I diagnostic trouble codes; clear codes.	1	P	R
2. Retrieve and record stored OBD II diagnostic trouble codes; clear codes.	3	P	R
3. Diagnose the causes of emissions or driveability concerns resulting from failure of computerized engine controls with stored diagnostic trouble codes.	1	I	P
4. Diagnose emissions or driveability concerns resulting from failure of computerized engine controls with no stored diagnostic trouble codes; determine necessary action.	1	I	P
5. Inspect and test computerized engine control system sensors, powertrain control module (PCM), actuators, and circuits; perform necessary action.	2	I	P
6. Obtain and interpret digital multimeter (DMM) readings.	1	P	R
7. Access and use electronic service information (ESI).	3	P	R
8. Locate and interpret vehicle and major component identification numbers (VIN, vehicle certification labels, and calibration decals).	1	P	
9. Inspect and test power and ground circuits and connections; service or replace as needed.	1	P	R
10. Practice recommended precautions when handling static sensitive devices.	2	P	R
11. Diagnose driveability and emissions problems resulting from failures of interrelated systems (cruise control, security alarms, suspension controls, traction controls, A/C, automatic transmissions, non-OEM-installed accessories, and similar systems); determine necessary action.	2	I	P
C. Ignition System Diagnosis and Repair			
1. Diagnose no-starting, driveability, and emissions concerns on vehicles with electronic ignition (EI/DIS) (distributorless) systems; determine necessary action.	1	I	P
2. Diagnose no-starting, driveability, and emissions concerns on	1	I	P

Task	P	12	AD
vehicles with distributor ignition (DI) systems; determine necessary action.			
3. Inspect and test ignition primary circuit wiring and components; perform necessary action.	2	P	R
4. Inspect and test distributor; perform necessary action.	3	P	PR
5. Inspect and test ignition system secondary circuit wiring and components; perform necessary action.	2	P	R
6. Inspect and test ignition coil(s); perform necessary action.	2	P	R
7. Check and adjust (where applicable) ignition system timing and timing advance/retard.	1	P	
8. Inspect and test ignition system pick-up sensor or triggering devices; perform necessary action.	2	IR	PR
9. Inspect and test ignition control module; perform necessary action.	2	IR	PR
D. Fuel, Air Induction, and Exhaust Systems Diagnosis and Repair			
1. Diagnose hot or cold no-starting, hard starting, poor driveability, incorrect idle speed, poor idle, flooding, hesitation, surging, engine misfire, power loss, stalling, poor mileage, dieseling, and emissions problems on vehicles with carburetor-type fuel systems; determine necessary action.	3	I	P
2. Diagnose hot or cold no-starting, hard starting, poor driveability, incorrect idle speed, poor idle, flooding, hesitation, surging, engine misfire, power loss, stalling, poor mileage, dieseling, and emissions problems on vehicles with injection-type fuel systems; determine necessary action.	1	I	P
3. Inspect fuel tank and fuel cap, fuel lines, fittings, and hoses, perform necessary action.	2	P	PR
4. Check fuel for contaminants and quality; determine necessary action.	2	I	P
5. Inspect and test mechanical and electrical fuel pumps and pump control systems; perform necessary action.	2	IR	PR
6. Replace fuel filters.	1	P	
7. Inspect and test fuel pressure regulation system and components of injection-type fuel systems; perform necessary action.	1	I	P
8. Inspect and test cold enrichment system and components; perform necessary action.	3	I	P
9. Remove, service, and install throttle body; adjust related linkages.	2	P	R
10. Inspect, test, and clean fuel injectors.	2	IR	PR
11. Inspect throttle body mounting plates, air induction and filtration system, intake manifold, and gaskets; perform necessary action.	2	P	R
12. Check idle speed and fuel mixture.	2	P	PR
13. Adjust (carbureted) idle speed and fuel mixture.	3	P	PR
14. Remove, inspect, and test vacuum and electrical circuits, components and connections of fuel system; perform necessary	2	I	P

Task	P	12	AD
action.			
15. Inspect exhaust manifold, exhaust pipes, muffler(s), catalytic converter(s), resonator(s), tail pipe(s), and heat shield(s); perform necessary action.	2	P	R
16. Perform exhaust system back-pressure test; determine necessary action.	1	I	
17. Test the operation of turbocharger/supercharger systems; determine necessary action.	3	I	P
E. Emissions Control Systems Diagnosis and Repair			
1. Positive Crankcase Ventilation			
1. Diagnose oil leaks, emissions, and driveability problems resulting from failure of the positive crankcase ventilation (PCV) system; determine necessary action.	1	P	R
2. Inspect and test positive crankcase ventilation (PCV) filter/breather cap, valve, tubes, orifices, and hoses; perform necessary action.	2	P	R
2. Exhaust Gas Recirculation			
1. Diagnose emissions and driveability problems caused by failure of the exhaust gas recirculation (EGR) system; determine necessary action.	1	I	P
2. Inspect and test valve, valve manifold, and exhaust passages of exhaust gas recirculation (EGR) systems; perform necessary action.	2	IR	PR
3. Inspect and test vacuum/pressure controls, filters, and hoses of exhaust gas recirculation (EGR) systems; perform necessary action.	2	I	P
4. Inspect and test electrical/electronic sensors, controls, and wiring of exhaust gas recirculation (EGR) systems; perform necessary action.	2	I	P
3. Exhaust Gas Treatment			
1. Diagnose emissions and driveability problems resulting from failure of the secondary air injection and catalytic converter systems; determine necessary action.	2	I	PR
2. Inspect and test mechanical components of secondary air injection systems; perform necessary action.	2	I	PR
3. Inspect and test electrical/electronically-operated components and circuits of air injection systems; perform necessary action.	2	I	P
4. Inspect and test components of catalytic converter systems; perform necessary action.	2	IR	PR
4. Intake Air Temperature Controls			
1. Diagnose emissions and driveability problems resulting from failure of the intake air temperature control system; determine necessary action.	3	I	PR
2. Inspect and test components of intake air temperature control system; perform necessary action.	3	I	PR

Task	P	12	AD
5. Early Fuel Evaporation (Intake Manifold Temperature) Controls			
1. Diagnose emissions and driveability problems resulting from failure of early fuel evaporation control system; determine necessary action.	3	I	PR
2. Inspect and test components of early fuel evaporation control system; perform necessary action.	3	I	PR
6. Evaporative Emissions Controls			
1. Diagnose emissions and driveability problems resulting from failure of evaporative emissions control system; determine necessary action.	2	I	P
2. Inspect and test components and hoses of evaporative emissions control system; perform necessary action.	2	IR	PR
F. Engine Related Service			
1. Adjust valves on engines with mechanical or hydraulic lifters.	1	P	
2. Verify correct camshaft timing; determine necessary action.	1	P	
3. Verify engine operating temperature; determine necessary action.	1	P	
4. Perform cooling system pressure tests; check coolant condition; inspect and test radiator, pressure cap, coolant recovery tank, and hoses; perform necessary action.	1	P	
5. Inspect and test thermostat, by-pass, and housing; perform necessary action.	1	P	
6. Inspect and test mechanical/electrical fans, fan clutch, fan shroud/ducting, air dams, and fan control devices; perform necessary action.	2	IR	PR

AREA 1: SUSPENSION AND STEERING

For every task in Suspension and Steering, the following safety requirement must be strictly enforced:

Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.

Task	P	12	AD
A. Steering Systems Diagnosis and Repair			
1. Disable and enable supplemental restraint system (SRS) in accordance with manufacturer's procedures.	1	I	PR
2. Remove and replace steering wheel; center/time supplemental restraint system (SRS) coil in accordance with manufacturer's procedures.	1	I	P
3. Diagnose steering column noises, looseness, and binding concerns (including tilt mechanisms); determine necessary action.	3	IR	PR
4. Diagnose power steering gear (non-rack and pinion) binding, uneven turning effort, looseness, hard steering, and fluid leakage concerns; determine necessary action.	3	IR	PR
5. Diagnose power steering gear (rack and pinion) binding, uneven turning effort, looseness, hard steering, and fluid leakage concerns; determine necessary action.	3	IR	PR
6. Inspect steering shaft universal-joint(s), flexible coupling(s), collapsible column, lock cylinder mechanism, and steering wheel; perform necessary action.	2	IR	PR
7. Adjust manual or power non-rack and pinion worm bearing preload and sector lash.	3	I	P
8. Remove and replace manual or power rack and pinion steering gear; inspect mounting bushings and brackets.	2	P	
9. Disassemble, inspect, perform necessary action and reassemble rack and pinion steering gear.	3	I	R
10. Adjust manual or power rack and pinion steering gear.	3	I	
11. Inspect and replace manual or power rack and pinion steering gear inner tie rod ends (sockets) and bellows boots.	2	P	
12. Inspect power steering fluid levels and condition.	1	P	
13. Flush, fill, and bleed power steering system.	2	P	R
14. Diagnose power steering fluid leakage; determine necessary action.	2	P	
15. Remove, inspect, replace, and adjust power steering pump belt.	1	P	
16. Remove, inspect, and replace power steering pump, mounts, seals, and gaskets.	3	P	PR
17. Remove, inspect, and replace power steering pump pulley; check alignment.	3	P	R
18. Inspect and replace power steering hoses and fittings.	2	P	
19. Inspect and replace pitman arm, relay (centerlink/intermediate) rod, idler arm and mountings, and steering linkage damper.	3	P	R
20. Inspect, replace, and adjust tie rod ends (sockets), tie rod sleeves, and clamps.	2	P	

Task	P	12	AD
21. Diagnose and adjust components of electronically controlled steering systems; determine necessary action.	3	I	P
B. Suspension Systems Diagnosis and Repair			
4. Front Suspension			
1. Diagnose short and long arm suspension system noises, body sway, and uneven riding height concerns; determine necessary action.	1	I	P
2. Diagnose MacPherson strut suspension system noises, body sway, and uneven riding height concerns; determine necessary action.	1	I	P
3. Remove, inspect, and install upper and lower control arms, bushings, shafts, and rebound bumpers.	2	P	
4. Remove, inspect, install, and adjust strut (compression/tension) rods and bushings.	2	P	
5. Remove, inspect, and install upper and lower ball joints on short and long arm suspension systems.	2	P	
6. Remove, inspect, and install steering knuckle assemblies.	2	P	
7. Remove, inspect, and install short and long arm suspension system coil springs and spring insulators.	2	P	
8. Remove, inspect, install, and adjust suspension system torsion bars; inspect mounts.	3	P	R
9. Remove, inspect, and install stabilizer bar bushings, brackets, and links.	3	P	R
10. Remove, inspect, and install MacPherson strut cartridge or assembly, strut coil spring, insulators (silencers), and upper strut bearing mount.	1	P	
11. Lubricate suspension and steering systems.	2	P	
5. Rear Suspension			
1. Remove, inspect, and install coil springs and spring insulators.	2	P	
2. Remove, inspect, and install transverse links, control arms, bushings, and mounts.	2	P	
3. Remove, inspect, and install leaf springs, leaf spring insulators (silencers), shackles, brackets, bushings, and mounts.	3	P	R
4. Remove, inspect, and install MacPherson strut cartridge or assembly, strut coil spring, and insulators (silencers).	2	P	
6. Miscellaneous Service			
1. Inspect, remove, and replace shock absorbers.	1	P	
2. Remove, inspect, and service or replace front and rear wheel bearings.	1	P	
3. Diagnose, inspect, adjust, repair or replace components of electronically controlled suspension systems.	2	I	P
C. Wheel Alignment Diagnosis, Adjustment, and Repair			
1. Diagnose vehicle wander, drift, pull, hard steering, bump steer, memory steer, torque steer, and steering return concerns; determine necessary action.	1	I	P
2. Perform prealignment inspection; perform necessary action.	1	P	R
3. Measure vehicle riding height; determine necessary action.	1	P	R
4. Check and adjust front and rear wheel camber; perform necessary action.	1	P	R
5. Check and adjust caster; perform necessary action.	1	P	R
6. Check and adjust front wheel toe; adjust as needed.	1	P	R
7. Center steering wheel.	1	P	R
8. Check toe-out-on-turns (turning radius); determine necessary action.	2	IR	PR
9. Check SAI (steering axis inclination) and included angle; determine necessary action.	2	IR	PR
10. Check and adjust rear wheel toe.	2	IR	PR
11. Check rear wheel thrust angle; determine necessary action.	2	IR	PR
12. Check for front wheel setback; determine necessary action.	2	IR	PR
13. Check front cradle (subframe) alignment; determine necessary action.	3	P	R

Task	P	12	AD
D. Wheel and Tire Diagnosis and Repair			
1. Diagnose tire wear patterns; determine necessary action.	1	P	
2. Inspect tires; check and adjust air pressure.	1	P	
3. Diagnose wheel/tire vibration, shimmy, and noise; determine necessary action.	2	P	
4. Rotate tires according to manufacturer's recommendations.	1	P	
5. Measure wheel, tire, axle, and hub runout; determine necessary action.	2	P	
6. Diagnose tire pull (lead) problem; determine necessary action.	2	P	
7. Balance wheel and tire assembly (static and dynamic).	1	P	
8. Dismount, inspect, repair, and remount tire on wheel.	2	P	
9. Reinstall wheel; torque lug nuts.	1	P	

AREA 2: BRAKES--Priority One (22)

Task	12	AD
A. Hydraulic System Diagnosis and Repair		
3. Remove, bench bleed, and reinstall master cylinder.	P	
4. Diagnose poor stopping, pulling or dragging concerns caused by problems in the hydraulic system; determine necessary action.	P	
7. Select, handle, store, and install brake fluids to proper level.	P	
11. Bleed (manual, pressure, vacuum or surge) brake system.	P	
B. Drum Brake Diagnosis and Repair		
1. Diagnose poor stopping, noise, pulling, grabbing, dragging or pedal pulsation concerns; determine necessary action.	P	
2. Remove, clean (using proper safety procedures), inspect, and measure brake drums; service or replace as needed.	P	
6. Pre-adjust brake shoes and parking brake before installing brake drums or drum/hub assemblies and wheel bearings.	P	
7. Install wheel, torque lug nuts, and make final checks and adjustments.	P	
C. Disc Brake Diagnosis and Repair		
1. Diagnose poor stopping, noise, pulling, grabbing, dragging or pedal pulsation concerns; determine necessary action.	P	
2. Remove caliper assembly from mountings; clean and inspect for leaks and damage to caliper housing; determine necessary action.	P	
3. Clean and inspect caliper mounting and slides for wear and damage; determine necessary action.	P	
4. Remove, clean, and inspect pads and retaining hardware; determine necessary action.	P	
5. Disassemble and clean caliper assembly; inspect parts for wear, rust, scoring, and damage; replace seal, boot, and damaged or worn parts.	P	
6. Reassemble, lubricate, and reinstall caliper, pads, and related hardware; seat pads, and inspect for leaks.	P	
7. Clean, inspect, and measure rotor with a dial indicator and a micrometer; follow manufacturer's recommendations in determining need to machine or replace.	P	
8. Refinish rotor according to manufacturer's recommendations.	P	
10. Install wheel, torque lug nuts, and make final checks and adjustments.	P	
D. Power Assist Units Diagnosis and Repair (NONE)		
E. Miscellaneous (Wheel Bearings, Parking Brakes, Electrical, Etc.) Diagnosis and Repair		
1. Diagnose wheel bearing noises, wheel shimmy, and vibration concerns; determine necessary action.	P	

Task	12	AD
2. Remove, clean, inspect, repack, and install wheel bearings and replace seals; install hub and adjust wheel bearings.	P	
4. Check parking brake operation; adjust as needed.	P	
6. Check operation of brake stop light system; adjust and service as needed.	P	
7. Replace wheel bearing and race.	P	
F. Anti-lock Brake System		
3. Diagnose anti-lock brake system (ABS) electronic control(s) and components using self-diagnosis and/or recommended test equipment; determine necessary action.	P	

AREA 2: BRAKES--Priority Two (14)

Task	12	AD
A. Hydraulic System Diagnosis and Repair		
1. Measure and adjust pedal height.	P	
2. Check master cylinder for internal and external leaks and proper operation; determine necessary action.	P	
5. Inspect brake lines, flexible hoses, and fittings for leaks, dents, kinks, rust, cracks, bulging or wear; tighten loose fittings and supports; determine necessary action.	P	
6. Fabricate and install brake lines (double flare and ISO types); replace hoses, fittings, and supports as needed.	P	
B. Drum Brake Diagnosis and Repair		
3. Mount brake drum on lathe; machine braking surface.	P	
4. Remove, clean, and inspect brake shoes, springs, pins, clips, levers, adjusters/self-adjusters, other related brake hardware, and backing support plates; lubricate and reassemble.	P	
5. Remove, inspect, and install wheel cylinders.	P	
C. Disc Brake Diagnosis and Repair		
11. Remove and replace rotor.	P	
D. Power Assist Units Diagnosis and Repair		
1. Test pedal free travel with and without engine running; check power assist operation.	P	PR
2. Check vacuum supply (manifold or auxiliary pump) to vacuum-type power booster.	P	
3. Inspect the vacuum-type power booster unit for vacuum leaks; inspect the check valve for proper operation; determine necessary action.	P	
E. Miscellaneous (Wheel Bearings, Parking Brakes, Electrical, Etc.) Diagnosis and Repair		
3. Check parking brake cables and components for wear, rusting, binding, and corrosion; clean, lubricate, and replace as needed.	P	
F. Anti-lock Brake System		
1. Inspect and test anti-lock brake system (ABS) components; determine necessary action.	P	R
2. Diagnose poor stopping, wheel lock-up, abnormal pedal feel or pulsation, and noise concerns caused by the anti-lock brake system (ABS); determine necessary action.	P	R
4. Depressurize high-pressure components of the anti-lock brake system (ABS).	P	R
5. Bleed the anti-lock brake system's (ABS) front and rear hydraulic circuits.	P	R
7. Service, test, and adjust anti-lock brake system (ABS) speed sensors.	IR	PR

AREA 2: BRAKES--Priority Three (5)

Task	12	AD
A. Hydraulic System Diagnosis and Repair		
8. Inspect, test, and replace metering (hold-off), proportioning (balance), pressure differential, and combination valves.	P	R
9. Inspect, test, replace, and adjust height (load) sensing proportioning valve.	IR	PR
10. Inspect, test, and replace components of brake warning light system.	P	R
12. Flush hydraulic system.	P	
B. Drum Brake Diagnosis and Repair (NONE)		

C. Disc Brake Diagnosis and Repair		
9. Adjust calipers with integrated parking brake system.	P	PR
D. Power Assist Units Diagnosis and Repair		
4. Inspect and test hydro-boost system and accumulator for leaks and proper operation; determine necessary action.	P	R
E. Miscellaneous (Wheel Bearings, Parking Brakes, Electrical, Etc.) Diagnosis and Repair		
5. Check operation of parking brake indicator light system.	P	
F. Anti-lock Brake System		
6. Remove and install anti-lock brake system (ABS) electrical/electronic and hydraulic components.	I	P
8. Diagnose anti-lock brake system (ABS) braking concerns caused by vehicle modifications (tire size, curb height, final drive ratio, etc.).	I	P

AREA 3: ELECTRICAL/ELECTRONIC SYSTEMS

For every task in Electrical/Electronic Systems, the following safety requirement must be strictly enforced:

Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.

Task	P	12	AD
A. General Electrical System Diagnosis			
1. Use wiring diagrams during diagnosis of electrical circuit problems.	1	P	
2. Check electrical circuits with a test light; determine necessary action.	2	P	R
3. Check voltage and voltage drop in electrical/electronic circuits using a digital multimeter (DMM); determine necessary action.	1	P	
4. Check current flow in electrical/electronic circuits and components using an ammeter; determine necessary action.	1	P	
5. Check continuity and resistances in electrical/electronic circuits and components with an ohmmeter; determine necessary action.	1	P	
6. Check electrical circuits using jumper wires; determine necessary action.	2	P	R
7. Locate shorts, grounds, opens, and resistance problems in electrical/electronic circuits; determine necessary action.	1	P	
8. Measure and diagnose the cause(s) of abnormal key-off battery drain; determine necessary action.	1	P	
9. Inspect and test fusible links, circuit breakers, and fuses; determine necessary action.	1	P	
10. Inspect and test switches, connectors, relays, and wires of electrical/electronic circuits; perform necessary action.	1	P	
11. Repair wiring harnesses and connectors.	1	P	
12. Perform solder repair of electrical wiring.	1	P	
B. Battery Diagnosis and Service			
1. Perform battery state-of-charge test; determine needed service.	1	P	
2. Perform battery capacity test; determine needed service.	1	P	
3. Maintain or restore electronic memory functions.	2	P	R
4. Inspect, clean, fill, and replace battery.	2	P	PR
5. Perform slow/fast battery charge.	2	P	PR
6. Inspect and clean battery cables, connectors, clamps, and hold-downs; repair or replace as needed.	1	P	
7. Start a vehicle using jumper cables and a battery or auxiliary power supply according to manufacturers recommended specifications.	1	P	
C. Starting System Diagnosis and Repair			
1. Perform starter current draw tests; determine necessary action.	1	P	
2. Perform starter circuit voltage drop tests; determine necessary action.	1	P	
3. Inspect and test starter relays and solenoids; replace as needed.	2	IR	PR
4. Remove and install starter.	2	P	

Task	P	12	AD
5. Perform starter bench tests; determine necessary action.	3	IR	PR
6. Inspect and test switches, connectors, and wires of starter control circuits; perform necessary action.	2	P	R
7. Disassemble, clean, inspect, and test starter components; replace as needed.	3	IR	PR
D. Charging System Diagnosis and Repair			
1. Perform charging system output test; determine necessary action.	1	P	
2. Diagnose charging system for the cause of undercharge, no-charge, and overcharge conditions.	1	P	
3. Inspect and adjust generator (alternator) drive belts; replace as needed.	1	P	
4. Inspect and test voltage regulator/regulating circuit; perform necessary action.	2	P	R
5. Remove inspect, and install generator (alternator).	2	P	PR
6. Disassemble generator (alternator), clean, inspect, and test components; determine necessary action.	3	IR	PR
7. Perform charging circuit voltage drop tests; determine necessary action.	1	P	
E. Lighting Systems Diagnosis and Repair			
1. Diagnose the cause of brighter than normal, intermittent, dim, or no light operation; determine necessary action.	2	P	PR
2. Inspect, replace, and aim headlights and bulbs.	2	P	
3. Inspect and diagnose incorrect turn signal or hazard light operation; perform necessary action.	2	P	PR
F. Gauges, Warning Devices, and Driver Information Systems Diagnosis and Repair			
1. Inspect and test gauges and gauge sending units for cause of intermittent, high, low, or no gauge readings; determine necessary action.	2	I	P
2. Inspect and test connectors, wires, and printed circuit boards of gauge circuits; determine necessary action.	3	I	P
3. Diagnose the cause of incorrect operation of warning devices and other driver information systems; determine necessary action.	1	P	
4. Inspect and test sensors, connectors, and wires of electronic instrument circuits; determine necessary action.	3	I	P
G. Horn and Wiper/Washer Diagnosis and Repair			
1. Diagnose incorrect horn operation; perform necessary action.	3	P	R
2. Diagnose incorrect wiper operation; diagnose wiper speed control and park problems; perform necessary action.	3	IR	PR
3. Diagnose incorrect windshield washer operation; perform necessary action.	3	P	PR
H. Accessories Diagnosis and Repair			
1. Diagnose incorrect operation of motor-driven accessory circuits; determine necessary action.	2	I	P
2. Diagnose incorrect heated glass operation; determine necessary action.	3	P	PR
3. Diagnose incorrect electric lock operation; determine necessary action.	3	IR	PR
4. Diagnose incorrect operation of cruise control systems; repair as needed.	3	IR	PR
5. Diagnose supplemental restraint system (SRS) concerns; determine necessary action. (Note: Follow manufacturer's safety procedures to prevent accidental deployment.)	2	I	PR
6. Diagnose radio static and weak, intermittent, or no radio reception; determine necessary action.	3	I	P

AREA 4: ENGINE PERFORMANCE

For every task in Engine Performance, the following safety requirement must be strictly enforced:

Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.

Task	P	12	AD
A. General Engine Diagnosis			
1. Interpret and verify concern; determine necessary action.	1	I	P
2. Inspect engine assembly for fuel, oil, coolant, and other leaks; determine necessary action.	2	P	R
3. Diagnose unusual engine noise or vibration concerns; determine necessary action.	2	I	P
4. Diagnose unusual exhaust color, odor, and sound; determine necessary action.	2	I	P
5. Perform engine absolute (vacuum/boost) manifold pressure tests; determine necessary action.	1	P	R
6. Perform cylinder power balance test; determine necessary action.	1	P	
7. Perform cylinder compression test; determine necessary action.	1	P	
8. Perform cylinder leakage test; determine necessary action.	1	P	
9. Diagnose engine mechanical, electrical, electronic, fuel, and ignition concerns with an oscilloscope and engine diagnostic equipment; determine necessary action.	1	I	P

Task	P	12	AD
10. Prepare 4 or 5 gas analyzer; inspect and prepare vehicle for test, and obtain exhaust readings; interpret readings, and determine necessary action.	1	I	P
B. Computerized Engine Controls Diagnosis and Repair			
1. Retrieve and record stored OBD I diagnostic trouble codes; clear codes.	1	P	R
2. Retrieve and record stored OBD II diagnostic trouble codes; clear codes.	3	P	R
3. Diagnose the causes of emissions or driveability concerns resulting from failure of computerized engine controls with stored diagnostic trouble codes.	1	I	P
4. Diagnose emissions or driveability concerns resulting from failure of computerized engine controls with no stored diagnostic trouble codes; determine necessary action.	1	I	P
5. Inspect and test computerized engine control system sensors, powertrain control module (PCM), actuators, and circuits; perform necessary action.	2	I	P
6. Obtain and interpret digital multimeter (DMM) readings.	1	P	R
7. Access and use electronic service information (ESI).	3	P	R
8. Locate and interpret vehicle and major component identification numbers (VIN, vehicle certification labels, and calibration decals).	1	P	
9. Inspect and test power and ground circuits and connections; service or replace as needed.	1	P	R
10. Practice recommended precautions when handling static sensitive devices.	2	P	R
11. Diagnose driveability and emissions problems resulting from failures of interrelated systems (cruise control, security alarms, suspension controls, traction controls, A/C, automatic transmissions, non-OEM-installed accessories, and similar systems); determine necessary action.	2	I	P

Task	P	12	AD
C. Ignition System Diagnosis and Repair			
1. Diagnose no-starting, driveability, and emissions concerns on vehicles with electronic ignition (EI/DIS) (distributorless) systems; determine necessary action.	1	I	P
2. Diagnose no-starting, driveability, and emissions concerns on vehicles with distributor ignition (DI) systems; determine necessary action.	1	I	P
3. Inspect and test ignition primary circuit wiring and components; perform necessary action.	2	P	R
4. Inspect and test distributor; perform necessary action.	3	P	PR
5. Inspect and test ignition system secondary circuit wiring and components; perform necessary action.	2	I	P
6. Inspect and test ignition coil(s); perform necessary action.	2	P	R
7. Check and adjust (where applicable) ignition system timing and timing advance/retard.	1	P	
8. Inspect and test ignition system pick-up sensor or triggering devices; perform necessary action.	2	IR	PR
9. Inspect and test ignition control module; perform necessary action.	2	IR	PR
D. Fuel, Air Induction, and Exhaust Systems Diagnosis and Repair			
1. Diagnose hot or cold no-starting, hard starting, poor driveability, incorrect idle speed, poor idle, flooding, hesitation, surging, engine misfire, power loss, stalling, poor mileage, dieseling, and emissions problems on vehicles with carburetor-type fuel systems; determine necessary action.	3	I	P
2. Diagnose hot or cold no-starting, hard starting, poor driveability, incorrect idle speed, poor idle, flooding, hesitation, surging, engine misfire, power loss, stalling, poor mileage, dieseling, and emissions problems on vehicles with injection-type fuel systems; determine necessary action.	1	I	P
3. Inspect fuel tank and fuel cap, fuel lines, fittings, and hoses, perform necessary action.	2	P	PR
4. Check fuel for contaminants and quality; determine necessary action.	2	I	P
5. Inspect and test mechanical and electrical fuel pumps and pump control systems; perform necessary action.	2	IR	PR
6. Replace fuel filters.	1	P	
7. Inspect and test fuel pressure regulation system and components of injection-type fuel systems; perform necessary action.	1	I	P
8. Inspect and test cold enrichment system and components; perform necessary action.	3	I	P
9. Remove, service, and install throttle body; adjust related linkages.	2	P	R
10. Inspect, test, and clean fuel injectors.	2	IR	PR
11. Inspect throttle body mounting plates, air induction and filtration system, intake manifold, and gaskets; perform necessary action.	2	P	R
12. Check idle speed and fuel mixture.	2	P	PR
13. Adjust (carbureted) idle speed and fuel mixture.	3	I	P
14. Remove, inspect, and test vacuum and electrical circuits, components and connections of fuel system; perform necessary action.	2	I	P
15. Inspect exhaust manifold, exhaust pipes, muffler(s), catalytic converter(s), resonator(s), tail pipe(s), and heat shield(s); perform necessary action.	2	P	R
16. Perform exhaust system back-pressure test; determine necessary action.	1	I	
17. Test the operation of turbocharger/supercharger systems; determine necessary action.	3	I	P
E. Emissions Control Systems Diagnosis and Repair			
1. Positive Crankcase Ventilation			
1. Diagnose oil leaks, emissions, and driveability problems resulting from failure of the positive crankcase ventilation (PCV) system; determine necessary	1	P	R

Task	P	12	AD
action.			
2. Inspect and test positive crankcase ventilation (PCV) filter/breather cap, valve, tubes, orifices, and hoses; perform necessary action.	2	P	R
2. Exhaust Gas Recirculation			
1. Diagnose emissions and driveability problems caused by failure of the exhaust gas recirculation (EGR) system; determine necessary action.	1	I	P
2. Inspect and test valve, valve manifold, and exhaust passages of exhaust gas recirculation (EGR) systems; perform necessary action.	2	IR	PR
3. Inspect and test vacuum/pressure controls, filters, and hoses of exhaust gas recirculation (EGR) systems; perform necessary action.	2	I	P
4. Inspect and test electrical/electronic sensors, controls, and wiring of exhaust gas recirculation (EGR) systems; perform necessary action.	2	I	P
3. Exhaust Gas Treatment			
1. Diagnose emissions and driveability problems resulting from failure of the secondary air injection and catalytic converter systems; determine necessary action.	2	I	PR
2. Inspect and test mechanical components of secondary air injection systems; perform necessary action.	2	I	PR
3. Inspect and test electrical/electronically-operated components and circuits of air injection systems; perform necessary action.	2	I	P
4. Inspect and test components of catalytic converter systems; perform necessary action.	2	IR	PR
4. Intake Air Temperature Controls			
1. Diagnose emissions and driveability problems resulting from failure of the intake air temperature control system; determine necessary action.	3	I	PR
2. Inspect and test components of intake air temperature control system; perform necessary action.	3	I	PR
5. Early Fuel Evaporation (Intake Manifold Temperature) Controls			
1. Diagnose emissions and driveability problems resulting from failure of early fuel evaporation control system; determine necessary action.	3	I	PR
2. Inspect and test components of early fuel evaporation control system; perform necessary action.	3	I	PR
6. Evaporative Emissions Controls			
1. Diagnose emissions and driveability problems resulting from failure of evaporative emissions control system; determine necessary action.	2	I	P
2. Inspect and test components and hoses of evaporative emissions control system; perform necessary action.	2	IR	PR
F. Engine Related Service			
1. Adjust valves on engines with mechanical or hydraulic lifters.	1	P	
2. Verify correct camshaft timing; determine necessary action.	1	P	
3. Verify engine operating temperature; determine necessary action.	1	P	
4. Perform cooling system pressure tests; check coolant condition; inspect and test radiator, pressure cap, coolant recovery tank, and hoses; perform necessary action.	1	P	
5. Inspect and test thermostat, by-pass, and housing; perform necessary action.	1	P	
6. Inspect and test mechanical/electrical fans, fan clutch, fan shroud/ducting, air dams, and fan control devices; perform necessary action.	2	IR	PR

AREA 5: ENGINE REPAIR

For every task in Engine Repair, the following safety requirement must be strictly enforced:

Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.

Task	P	12	AD
B. General Engine Diagnosis; Removal and Reinstallation (R & R)			
* 1. Verify and interpret engine concern; determine necessary action.	1	IR	PR
2. Inspect engine assembly for fuel, oil, coolant, and other leaks; determine necessary action.	2	P	R
3. Diagnose engine noises and vibrations; determine necessary action.	3	IR	PR
4. Diagnose the cause of excessive oil consumption, unusual engine exhaust color, odor, and sound; determine necessary action.	3	IR	PR
5. Perform engine vacuum tests; determine necessary action.	1	P	
6. Perform cylinder power balance tests; determine necessary action.	1	P	
7. Perform cylinder compression tests; determine necessary action.	1	P	
8. Perform cylinder leakage tests; determine necessary action.	1	P	
9. Remove engine (front-wheel drive); prepare for disassembly.	3	IR	PR
10. Reinstall engine (front-wheel drive).	3	IR	PR
11. Remove engine (rear-wheel drive); prepare for disassembly.	3	IR	PR
12. Reinstall engine (rear-wheel drive).	3	IR	PR
B. Cylinder Head and Valve Train Diagnosis and Repair			
1. Remove cylinder head(s); visually inspect cylinder head(s) for cracks; check gasket surface areas for warpage and leakage; check passage condition.	2	P	R
2. Install cylinder heads and gaskets; tighten according to manufacturer's specifications and procedures.	2	P	R
3. Inspect and test valve springs for squareness, pressure, and free height comparison; replace as needed.	3	I	P
4. Inspect valve spring retainers, locks, and valve grooves.	2	P	PR
5. Replace valve stem seals.	3	IR	PR
6. Inspect valve guides for wear; check valve guide height and stem-to-guide clearance; recondition or replace as needed.	3	IR	PR
7. Resurface valves; perform necessary action.	2	IR	PR
8. Resurface valve seats; perform necessary action.	2	IR	PR
9. Check valve face-to-seat contact and valve seat concentricity (runout); service seats and valves as needed.	3	IR	PR
10. Check valve spring assembled height and valve stem height; service valve and spring assemblies as needed.	2	IR	PR
11. Inspect pushrods, rocker arms, rocker arm pivots and shafts for wear, bending, cracks, looseness, and blocked oil passages (orifices); perform necessary action.	2	IR	PR
12. Inspect hydraulic or mechanical lifters; replace as needed.	2	IR	PR
13. Adjust valves (mechanical or hydraulic lifters).	1	P	
14. Inspect camshaft drives (including gear wear and backlash, sprocket and chain wear); replace as necessary.	2	IR	PR
* 15. Inspect and replace timing belt(s), overhead camdrive sprockets, and	1	P	

Task	P	12	AD
tensioners; check belt tension; adjust as necessary.			
16. Inspect camshaft for runout, journal wear and lobe wear.	3	IR	PR
17. Inspect and measure camshaft bearing for wear, damage, out-of-round, and alignment; determine necessary action.	3	IR	PR
18. Verify camshaft(s) timing according to manufacturer's specifications and procedure.	1	P	
C. Engine Block Assembly Diagnosis and Repair			
* 1. Inspect and replace pans, covers, gaskets, and seals.	2	P	PR
2. Inspect engine block for visible cracks, passage condition, core and gallery plug condition, and surface warpage; determine necessary action.	2	P	PR
* 3. Inspect internal and external threads; restore as needed (includes installing thread inserts).	1	P	
4. Remove cylinder wall ridges.	3	P	R
5. Inspect and measure cylinder walls for damage and wear; determine necessary action.	2	IR	PR
6. Deglaze and clean cylinder walls.	1	P	
7. Inspect and measure camshaft bearings for wear, damage, out-of-round, and alignment; determine necessary action.	3	IR	PR
8. Inspect crankshaft for surface cracks and journal damage; check oil passage condition; measure journal wear; determine necessary action.	3	IR	PR
9. Inspect and measure main and connecting rod bearings for damage, clearance, and end play; determine necessary action (includes the proper selection of bearings).	2	IR	PR
10. Identify piston and bearing wear patterns that indicate connecting rod alignment and main bearing bore problems; inspect rod alignment and bearing bore condition.	3	IR	PR
11. Inspect, measure, and service pistons and pins; determine necessary action.	2	IR	PR
12. Inspect, measure, and install piston rings.	2	IR	PR
13. Inspect, repair or replace crankshaft vibration damper (harmonic balancer).	3	P	PR
* 14. Reassemble engine components using correct gaskets and sealants.	2	P	R
15. Inspect auxiliary (balance, intermediate, idler, counterbalance or silencer) shaft(s); inspect shaft(s) and support bearing for damage and wear; determine necessary action; reinstall and time.	3	I	P
16. Prime engine lubrication system.	1	IR	PR
D. Lubrication and Cooling Systems Diagnosis and Repair			
* 1. Perform oil pressure tests; determine necessary action.	1	P	
2. Inspect oil pump gears or rotors, housing, pressure relief devices, and pump drive; perform necessary action.	3	IR	PR
3. Perform cooling system, cap, and recovery system tests (pressure, combustion leakage, and temperature); determine necessary action.	1	P	
4. Inspect, replace, and adjust drive belts, tensioners, and pulleys.	1	P	
* 5. Inspect and replace engine cooling and heater system hoses.	2	P	PR
* 6. Inspect, test, and replace thermostat and housing.	2	P	PR
* 7. Test coolant; drain and recover coolant; flush and refill cooling system with recommended coolant; bleed air as required.	1	P	
* 8. Inspect, test, remove, and replace water pump.	2	IR	PR
* 9. Remove and replace radiator.	2	IR	PR
* 10. Inspect, and test fan(s) (electrical or mechanical), fan clutch, fan shroud, and air dams.	2	IR	PR
11. Inspect auxiliary oil coolers; replace as needed.	3	P	PR
* 12. Inspect, test, and replace oil temperature and pressure switches and sensors.	2	IR	PR
13. Perform oil and filter change.	1	P	

*

AREA 6: AUTOMATIC TRANSMISSION AND TRANSAXLE

For every task in Automatic Transmission and Transaxle, the following safety requirement must be strictly enforced:

Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.

Task	P	12	AD
A. General Transmission and Transaxle Diagnosis			
1. Identify and interpret transmission concern; assure proper engine operation; determine necessary action.	1	I	P
* 2. Diagnose unusual fluid usage, level, and condition concerns; determine necessary action.	1	I	P
3. Perform pressure tests; determine necessary action.	1		P
4. Perform lock-up converter system tests; determine necessary action.	2		P
5. Diagnose electronic, mechanical, hydraulic, vacuum control system concerns; determine necessary action.	1	I	P
6. Diagnose noise and vibration concerns; determine necessary action.	3		P
B. Transmission and Transaxle Maintenance and Adjustment			
* 1. Inspect, adjust or replace throttle (TV) linkages or cables, check gear select indicator (as applicable).	1	I	P
* 2. Service transmission; perform visual inspection; replace fluids and filters.	1	P	PR
C. In-Vehicle Transmission and Transaxle Repair			
1. Inspect, adjust or replace (as applicable) vacuum modulator; inspect and repair or replace lines and hoses.	3	IR	P
2. Inspect, repair, and replace governor assembly.	3	P	PR
* 3. Inspect and replace external seals and gaskets.	2	I	P
4. Inspect extension housing, bushings and seals; perform necessary action.	3	IR	P
5. Inspect, leak test, flush, and replace cooler, lines, and fittings.	1	P	PR
* 6. Inspect and replace speedometer drive gear, driven gear, vehicle speed sensor (VSS), and retainers.	3	IR	P
7. Inspect and test, adjust, repair or replace transmission related electrical and electronic components (includes computers, solenoids, sensors, relays, switches, and harnesses).	1	I	P
* 8. Inspect, replace, and align powertrain mounts.	3	P	PR
D. Off-Vehicle Transmission and Transaxle Repair			
5. Removal, Disassembly, and Reinstallation			
1. Remove and reinstall transmission and torque converter (rear-wheel drive).	2	IR	P
2. Remove and reinstall transaxle and torque converter assembly.	2	IR	P
3. Disassemble, clean, and inspect transmission/transaxle.	1		P
4. Inspect, measure, clean, and replace valve body (includes surfaces and bores, springs, valves, sleeves, retainers, brackets, check-balls, screens, spacers, and gaskets), and torque valve body bolts.	2		P
5. Inspect servo bore, piston, seals, pin, spring, and retainers; determine necessary action.	3		P
6. Inspect accumulator bore, piston, seals, spring, and retainer; determine necessary action.	3		P
7. Assemble transmission/transaxle.	1		P
6. Oil Pump and Converter			

Task	P	12	AD
1. Inspect converter flex plate, attaching parts, pilot, pump drive, and seal areas.	2	IR	P
2. Measure torque converter endplay and check for interference; check stator clutch.	2		P
3. Inspect, measure, and replace oil pump assembly and components.	3		P
4. Check torque converter and transmission cooling system for contamination.	1		P
7. Gear Train, Shafts, Bushings and Case			
1. Measure endplay or preload; determine necessary action.	1		P
2. Inspect, measure, and replace thrust washers and bearings.	2		P
3. Inspect oil delivery seal rings, ring grooves, and sealing surface areas.	2		P
4. Inspect bushings; replace as needed.	2		P
5. Inspect and measure planetary gear assembly (includes sun, ring gear, thrust washers, planetary gears, and carrier assembly); replace as needed.	2		P
6. Inspect case bores, passages, bushings, vents, and mating surfaces; determine necessary action.	2		P
7. Inspect transaxle drive, link chains, sprockets, gears, bearings, and bushings; perform necessary action.	2		P
8. Inspect, measure, repair, adjust or replace transaxle final drive components.	2		P
9. Inspect and reinstall parking pawl, shaft, spring, and retainer; determine necessary action.	3		P
8. Friction and Reaction Units			
1. Inspect clutch drum, piston, check-balls, springs, retainers, seals, and friction and pressure plates; replace as needed.	2		P
2. Measure clutch pack clearance; adjust as needed.	1		P
3. Air test operation of clutch and servo assemblies.	1		P
4. Inspect roller and sprag clutch, races, rollers, sprags, springs, cages, and retainers; replace as needed.	2		P
5. Inspect bands and drums; adjust or replace as needed.	3		P

AREA 7: MANUAL DRIVE TRAIN AND AXLES

For every task in Manual Drive Train and Axles, the following safety requirement must be strictly enforced:

Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.

Task	P	12	AD
A. Clutch Diagnosis and Repair			
1. Diagnose clutch noise, binding, slippage, pulsation, and chatter; determine necessary action.	1	I	P
2. Inspect clutch pedal linkage, cables, automatic adjuster mechanisms, brackets, bushings, pivots, and springs; perform necessary action.	1	I	P
3. Inspect hydraulic clutch slave and master cylinders, lines, and hoses; perform necessary action.	1	I	P
4. Inspect release (throw-out) bearing, lever, and pivot; perform necessary action.	1	I	P
5. Inspect and replace clutch pressure plate assembly and clutch disc.	1	IR	P
6. Inspect, remove or replace crankshaft pilot bearing or bushing (as applicable).	1	IR	P
7. Inspect flywheel and ring gear for wear and cracks, measure runout; determine necessary action.	1	IR	P
8. Inspect engine block, clutch (bell) housing, and transmission/transaxle case mating surfaces; determine necessary action.	3	IR	PR
9. Measure flywheel-to-block runout and crankshaft endplay; determine necessary action.	3	IR	PR
B. Transmission/Transaxle Diagnosis and Repair			
1. Remove and reinstall transmission/transaxle.	2	IR	PR
2. Disassemble, clean, and reassemble transmission/transaxle components.	2	I	PR
3. Inspect transmission/transaxle case, extension housing, case mating surfaces, bores, bushings, and vents; perform necessary action.	3		P
4. Diagnose noise, hard shifting, jumping out of gear, and fluid leakage concerns; determine necessary action.	3	I	PR
5. Inspect, adjust, and reinstall shift linkages, brackets, bushings, cables, pivots, and levers.	3	IR	PR
6. Inspect and reinstall powertrain mounts.	3	P	PR
7. Inspect and replace gaskets, seals, and sealants; inspect sealing surfaces.	2	IR	PR
8. Remove and replace transaxle final drive.	3	I	PR
9. Inspect, adjust, and reinstall shift cover, forks, levers, grommets, shafts, sleeves, detent mechanism, interlocks, and springs.	2	I	PR
10. Measure endplay or preload (shim or spacer selection procedure) on transmission/transaxle shafts; perform necessary action.	1		P
11. Inspect and reinstall synchronizer hub, sleeve, keys (inserts), springs, and blocking rings.	2	I	PR
12. Inspect and reinstall speedometer drive gear, driven gear, vehicle speed sensor (VSS), and retainers.	2	IR	PR
13. Diagnose transaxle final drive assembly noise and vibration concerns;	3		P

Task	P	12	AD
determine necessary action.			
14. Remove, inspect, measure, adjust, and reinstall transaxle final drive pinion gears (spiders), shaft, side gears, side bearings, thrust washers, and case assembly.	2	I	PR
15. Inspect lubrication devices (oil pump or slingers); perform necessary action.	3		P
16. Inspect, test, and replace transmission/transaxle sensors and switches.	1	I	P
C. Drive Shaft and Half Shaft, Universal and Constant-Velocity (CV) Joint Diagnosis and Repair			
1. Diagnose constant-velocity (CV) joint noise and vibration concerns; determine necessary action.	2	IR	PR
2. Diagnose universal joint noise and vibration concerns; perform necessary action.	2	IR	PR
3. Replace front wheel drive (FWD) front wheel bearing.	2	I	PR
* 4. Inspect, service, and replace shafts, yokes, boots, and CV joints.	1	P	PR
5. Inspect, service, and replace shaft center support bearings.	3	IR	P
6. Check shaft balance; measure shaft runout; measure and adjust driveline angles.	3	I	P
D. Drive Axle Diagnosis and Repair			
4. Ring and Pinion Gears and Differential Case Assembly			
1. Diagnose noise and vibration concerns; determine necessary action.	2	I	PR
2. Diagnose fluid leakage concerns; determine necessary action.	2	P	PR
* 3. Inspect and replace companion flange and pinion seal; measure companion flange runout.	2	I	PR
4. Inspect ring gear and measure runout; determine necessary action.	2	I	PR
5. Remove, inspect, and reinstall drive pinion and ring gear, spacers, sleeves, and bearings.	2	I	PR
6. Measure and adjust drive pinion depth.	2	I	PR
7. Measure and adjust drive pinion bearing preload.	1	I	P
8. Measure and adjust side bearing preload and ring and pinion gear total backlash and backlash variation on a differential carrier assembly (threaded cup or shim types).	2	I	PR
9. Check ring and pinion tooth contact patterns; perform necessary action.	1	I	P
10. Disassemble, inspect, measure, and adjust or replace differential pinion gears (spiders), shaft side gears, side bearings, thrust washers, and case.	2	I	PR
11. Reassemble and reinstall differential case assembly; measure runout; determine necessary action.	2	I	PR
5. Limited Slip Differential			
1. Diagnose noise, slippage, and chatter concerns; determine necessary action.	3	I	PR
* 2. Inspect and flush differential housing; refill with correct lubricant.	2	P	PR
3. Inspect and reinstall clutch (cone or plate) components.	3		P
4. Measure rotating torque; determine necessary action.	3		P
6. Drive Axle Shaft			
1. Diagnose drive axle shafts, bearings, and seals for noise, vibration, and fluid leakage concerns; determine necessary action.	2	I	PR
* 2. Inspect and replace drive axle shaft wheel studs.	3	P	PR
* 3. Remove and replace drive axle shafts.	1	P	PR
4. Inspect and replace drive axle shaft seals, bearings, and retainers.	2	I	PR
5. Measure drive axle flange runout and shaft endplay; determine necessary action.	2	I	PR
E. Four-wheel Drive/All-wheel Drive Component Diagnosis and Repair			
1. Diagnose noise, vibration, and unusual steering concerns; determine necessary action.	3		P

Task	P	12	AD
2. Inspect, adjust, and repair shifting controls (mechanical, electrical, and vacuum), bushings, mounts, levers, and brackets.	3		P
3. Remove and reinstall transfer case.	3		P
4. Disassemble, service, and reassemble transfer case and components.	3		P
5. Inspect front-wheel bearings and locking hubs; perform necessary action.	3		P
6. Check drive assembly seals and vents; check lube level.	3	P	PR
* 7. Diagnose test, adjust, and replace electrical/electronic components of four-wheel drive systems.	3		P

AREA 8: HEATING AND AIR CONDITIONING

For every task in Heating and Air Conditioning, the following safety requirement must be strictly enforced:

Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.

Task	P	12	AD
A. A/C System Diagnosis and Repair			
1. Diagnose unusual operating noises in the A/C system; determine necessary action.	2	I	PR
* 2. Identify refrigerant type; conduct a performance test of the A/C system; determine necessary action.	1	I	P
* 3. Leak test A/C system; determine necessary action.	1	I	P
4. Inspect the condition of discharged oil; determine necessary action.	2	I	P
5. Select oil type; measure, and add oil to the A/C system as needed.	2	P	PR
B. Refrigeration System Component Diagnosis and Repair			
1. Compressor and Clutch			
1. Diagnose A/C system conditions that cause the protection devices (pressure, thermal, and PCM) to interrupt system operation; determine necessary action.	2	I	P
* 2. Inspect A/C compressor drive belts; replace and adjust as needed.	2	P	R
3. Inspect, test, and replace A/C compressor clutch components or assembly.	2	P	R
4. Remove and replace A/C compressor and mountings.	2	P	R
3. Evaporator, Condenser, and Related Components			
1. Determine need for A/C system filter; perform necessary action.	3	P	PR
2. Remove and inspect A/C system mufflers, hoses, lines, fittings, o-rings, seals, and service valves; perform necessary action.	2	P	R
* 3. Inspect A/C condenser for airflow restrictions; perform necessary action.	1	P	R
4. Remove and install receiver/drier or accumulator/drier.	2	P	R
5. Remove and install expansion valve or orifice (expansion) tube.	2	P	R
6. Inspect evaporator housing water drain; perform necessary action.	3	P	R
C. Heating, Ventilation, and Engine Cooling Systems Diagnosis and Repair			
1. Diagnose temperature control problems in the heater/ventilation system; determine necessary action.	2	IR	PR
2. Perform cooling system, cap, and recovery system tests (pressure, combustion leakage, and temperature); determine necessary action.	1	P	
* 3. Inspect engine cooling and heater system hoses and belts; perform necessary action.	1	P	
4. Inspect, test, and replace thermostat and housing.	1	P	
5. Determine coolant condition; drain and recover coolant.	1	P	

Task	P	12	AD
6. Flush system; refill system with recommended coolant; bleed system.	1	P	
7. Inspect and test fan, fan clutch (electrical and mechanical), fan shroud, and air dams; perform necessary action.	1	P	PR
8. Inspect and test electrical fan control system and circuits.	1	I	PR
9. Inspect and test heater control valve(s); perform necessary action.	2	P	R
D. Operating Systems and Related Controls Diagnosis and Repair			
1. Diagnose failures in the electrical controls of heating, ventilation, and A/C (HVAC) systems; determine necessary action.	2	IR	PR
2. Inspect and test A/C-heater blower, motors, resistors, switches, relays, wiring, and protection devices; perform necessary action.	2	IR	PR
3. Test A/C compressor load cut-off systems; determine necessary action.	3	I	P
4. Diagnose failures in the vacuum and mechanical components and controls of the heating, ventilation, and A/C (HVAC) system; determine necessary action.	2	IR	PR
5. Inspect and test A/C-heater control panel assembly; determine necessary action.	3	IR	PR
6. Inspect and test A/C-heater control cables and linkages; perform necessary action.	3	IR	PR
7. Inspect and test A/C-heater ducts, doors, hoses, and outlets; perform necessary action.	3	IR	PR
8. Check operation of automatic and semi-automatic heating, ventilation, and air-conditioning (HVAC) control systems; determine necessary action.	3	I	IR
E. Refrigerant Recovery, Recycling, and Handling			
* 1. Verify correct operation and maintenance of refrigerant handling equipment.	1	P	

Task	P	12	AD
* 2. Identify (by label application or use of a refrigerant identifier) and recover * A/C system refrigerant.	1	P	
* 3. Recycle refrigerant.	1	P	
4. Label and store refrigerant.	1	P	
* 5. Test recycled refrigerant for non-condensable gases.	1	P	
* 6. Evacuate and charge A/C system.	1	P	

AREA 1: SUSPENSION AND STEERING--Priority One (20)

Task	12	AD
A. Steering Systems Diagnosis and Repair		
1. Disable and enable supplemental restraint system (SRS) in accordance with manufacturer's procedures.	I	PR
2. Remove and replace steering wheel; center/time supplemental restraint system (SRS) coil in accordance with manufacturer's procedures.	I	P
12. Inspect power steering fluid levels and condition.	P	
15. Remove, inspect, replace, and adjust power steering pump belt.	P	
B. Suspension Systems Diagnosis and Repair		
1. Front Suspension		
1. Diagnose short and long arm suspension system noises, body sway, and uneven riding height concerns; determine necessary action.	I	P
2. Diagnose MacPherson strut suspension system noises, body sway, and uneven riding height concerns; determine necessary action.	I	P
10. Remove, inspect, and install MacPherson strut cartridge or assembly, strut coil spring, insulators (silencers), and upper strut bearing mount.	P	
2. Rear Suspension(NONE)		
3. Miscellaneous Service		
1. Inspect, remove, and replace shock absorbers.	P	
2. Remove, inspect, and service or replace front and rear wheel bearings.	P	
C. Wheel Alignment Diagnosis, Adjustment, and Repair		
1. Diagnose vehicle wander, drift, pull, hard steering, bump steer, memory steer, torque steer, and steering return concerns; determine necessary action.	I	P
2. Perform prealignment inspection; perform necessary action.	P	R
3. Measure vehicle riding height; determine necessary action.	P	R
4. Check and adjust front and rear wheel camber; perform necessary action.	P	R
5. Check and adjust caster; perform necessary action.	P	R
6. Check and adjust front wheel toe; adjust as needed.	P	R
7. Center steering wheel.	P	R
D. Wheel and Tire Diagnosis and Repair		
1. Diagnose tire wear patterns; determine necessary action.	P	
2. Inspect tires; check and adjust air pressure.	P	
4. Rotate tires according to manufacturer's recommendations.	P	
7. Balance wheel and tire assembly (static and dynamic).	P	

Task	12	AD
9. Reinstall wheel; torque lug nuts.	P	

AREA 1: SUSPENSION AND STEERING--Priority Two (21)

Task	12	AD
A. Steering Systems Diagnosis and Repair		
6. Inspect steering shaft universal-joint(s), flexible coupling(s), collapsible column, lock cylinder mechanism, and steering wheel; perform necessary action.	IR	PR
8. Remove and replace manual or power rack and pinion steering gear; inspect mounting bushings and brackets.	P	
11. Inspect and replace manual or power rack and pinion steering gear inner tie rod ends (sockets) and bellows boots.	P	
13. Flush, fill, and bleed power steering system.	P	R
14. Diagnose power steering fluid leakage; determine necessary action.	P	
18. Inspect and replace power steering hoses and fittings.	P	
20. Inspect, replace, and adjust tie rod ends (sockets), tie rod sleeves, and clamps.	P	
B. Suspension Systems Diagnosis and Repair		
1. Front Suspension		
3. Remove, inspect, and install upper and lower control arms, bushings, shafts, and rebound bumpers.	P	
4. Remove, inspect, install, and adjust strut (compression/tension) rods and bushings.	P	
5. Remove, inspect, and install upper and lower ball joints on short and long arm suspension systems.	P	
6. Remove, inspect, and install steering knuckle assemblies.	P	
7. Remove, inspect, and install short and long arm suspension system coil springs and spring insulators.	P	
11. Lubricate suspension and steering systems.	P	
2. Rear Suspension		
1. Remove, inspect, and install coil springs and spring insulators.	P	
2. Remove, inspect, and install transverse links, control arms, bushings, and mounts.	P	
4. Remove, inspect, and install MacPherson strut cartridge or assembly, strut coil spring, and insulators (silencers).	P	
3. Miscellaneous Service		
3. Diagnose, inspect, adjust, repair or replace components of electronically controlled suspension systems.	I	P
C. Wheel Alignment Diagnosis, Adjustment, and Repair		
8. Check toe-out-on-turns (turning radius); determine necessary action.	IR	PR
9. Check SAI (steering axis inclination) and included angle; determine necessary action.	IR	PR
10. Check and adjust rear wheel toe.	IR	PR
11. Check rear wheel thrust angle; determine necessary action.	IR	PR
12. Check for front wheel setback; determine necessary action.	IR	PR

Task	12	AD
D. Wheel and Tire Diagnosis and Repair		
3. Diagnose wheel/tire vibration, shimmy, and noise; determine necessary action.	P	
5. Measure wheel, tire, axle, and hub runout; determine necessary action.	P	
6. Diagnose tire pull (lead) problem; determine necessary action.	P	
8. Dismount, inspect, repair, and remount tire on wheel.	P	

AREA 1: SUSPENSION AND STEERING--Priority Three (7)

Task	12	AD
A. Steering Systems Diagnosis and Repair		
3. Diagnose steering column noises, looseness, and binding concerns (including tilt mechanisms); determine necessary action.	IR	PR
4. Diagnose power steering gear (non-rack and pinion) binding, uneven turning effort, looseness, hard steering, and fluid leakage concerns; determine necessary action.	IR	PR
5. Diagnose power steering gear (rack and pinion) binding, uneven turning effort, looseness, hard steering, and fluid leakage concerns; determine necessary action.	IR	PR
7. Adjust manual or power non-rack and pinion worm bearing preload and sector lash.	I	P
9. Disassemble, inspect, perform necessary action and reassemble rack and pinion steering gear.	I	R
10. Adjust manual or power rack and pinion steering gear.	I	
16. Remove, inspect, and replace power steering pump, mounts, seals, and gaskets.	P	PR
17. Remove, inspect, and replace power steering pump pulley; check alignment.	P	R
19. Inspect and replace pitman arm, relay (centerlink/intermediate) rod, idler arm and mountings, and steering linkage damper.	P	R
21. Diagnose and adjust components of electronically controlled steering systems; determine necessary action.	I	P
B. Suspension Systems Diagnosis and Repair		
1. Front Suspension		
8. Remove, inspect, install, and adjust suspension system torsion bars; inspect mounts.	P	R
9. Remove, inspect, and install stabilizer bar bushings, brackets, and links.	P	R
2. Rear Suspension		
3. Remove, inspect, and install leaf springs, leaf spring insulators (silencers), shackles, brackets, bushings, and mounts.	P	R
3. Miscellaneous Service (NONE)		
C. Wheel Alignment Diagnosis, Adjustment, and Repair		
13. Check front cradle (subframe) alignment; determine necessary action.	P	R
D. Wheel and Tire Diagnosis and Repair (NONE)		

AREA 2: BRAKES--Priority One (22)

Task	12	AD
A. Hydraulic System Diagnosis and Repair		
3. Remove, bench bleed, and reinstall master cylinder.	P	
4. Diagnose poor stopping, pulling or dragging concerns caused by problems in the hydraulic system; determine necessary action.	P	
7. Select, handle, store, and install brake fluids to proper level.	P	
11. Bleed (manual, pressure, vacuum or surge) brake system.	P	
B. Drum Brake Diagnosis and Repair		
1. Diagnose poor stopping, noise, pulling, grabbing, dragging or pedal pulsation concerns; determine necessary action.	P	
2. Remove, clean (using proper safety procedures), inspect, and measure brake drums; service or replace as needed.	P	
6. Pre-adjust brake shoes and parking brake before installing brake drums or drum/hub assemblies and wheel bearings.	P	
7. Install wheel, torque lug nuts, and make final checks and adjustments.	P	
C. Disc Brake Diagnosis and Repair		
1. Diagnose poor stopping, noise, pulling, grabbing, dragging or pedal pulsation concerns; determine necessary action.	P	
2. Remove caliper assembly from mountings; clean and inspect for leaks and damage to caliper housing; determine necessary action.	P	
3. Clean and inspect caliper mounting and slides for wear and damage; determine necessary action.	P	
4. Remove, clean, and inspect pads and retaining hardware; determine necessary action.	P	
5. Disassemble and clean caliper assembly; inspect parts for wear, rust, scoring, and damage; replace seal, boot, and damaged or worn parts.	P	
6. Reassemble, lubricate, and reinstall caliper, pads, and related hardware; seat pads, and inspect for leaks.	P	
7. Clean, inspect, and measure rotor with a dial indicator and a micrometer; follow manufacturer's recommendations in determining need to machine or replace.	P	
8. Refinish rotor according to manufacturer's recommendations.	P	
10. Install wheel, torque lug nuts, and make final checks and adjustments.	P	
D. Power Assist Units Diagnosis and Repair (NONE)		
E. Miscellaneous (Wheel Bearings, Parking Brakes, Electrical, Etc.) Diagnosis and Repair		
1. Diagnose wheel bearing noises, wheel shimmy, and vibration concerns; determine necessary action.	P	
2. Remove, clean, inspect, repack, and install wheel bearings and replace seals; install hub and adjust wheel bearings.	P	
4. Check parking brake operation; adjust as needed.	P	

Task	12	AD
6. Check operation of brake stop light system; adjust and service as needed.	P	
7. Replace wheel bearing and race.	P	
F. Anti-lock Brake System		
3. Diagnose anti-lock brake system (ABS) electronic control(s) and components using self-diagnosis and/or recommended test equipment; determine necessary action.	P	

AREA 2: BRAKES--Priority Two (14)

Task	12	AD
A. Hydraulic System Diagnosis and Repair		
1. Measure and adjust pedal height.	P	
2. Check master cylinder for internal and external leaks and proper operation; determine necessary action.	P	
5. Inspect brake lines, flexible hoses, and fittings for leaks, dents, kinks, rust, cracks, bulging or wear; tighten loose fittings and supports; determine necessary action.	P	
6. Fabricate and install brake lines (double flare and ISO types); replace hoses, fittings, and supports as needed.	P	
B. Drum Brake Diagnosis and Repair		
3. Mount brake drum on lathe; machine braking surface.	P	
4. Remove, clean, and inspect brake shoes, springs, pins, clips, levers, adjusters/self-adjusters, other related brake hardware, and backing support plates; lubricate and reassemble.	P	
5. Remove, Inspect, and install wheel cylinders.	P	
C. Disc Brake Diagnosis and Repair		
11. Remove and replace rotor.	P	
D. Power Assist Units Diagnosis and Repair		
1. Test pedal free travel with and without engine running; check power assist operation.	P	PR
2. Check vacuum supply (manifold or auxiliary pump) to vacuum-type power booster.	P	
3. Inspect the vacuum-type power booster unit for vacuum leaks; inspect the check valve for proper operation; determine necessary action.	P	
E. Miscellaneous (Wheel Bearings, Parking Brakes, Electrical, Etc.) Diagnosis and Repair		
3. Check parking brake cables and components for wear, rusting, binding, and corrosion; clean, lubricate, and replace as needed.	P	
F. Anti-lock Brake System		
1. Inspect and test anti-lock brake system (ABS) components; determine necessary action.	P	R
2. Diagnose poor stopping, wheel lock-up, abnormal pedal feel or pulsation, and noise concerns caused by the anti-lock brake system (ABS); determine necessary action.	P	R
4. Depressurize high-pressure components of the anti-lock brake system (ABS).	P	R
5. Bleed the anti-lock brake system's (ABS) front and rear hydraulic circuits.	P	R
7. Service, test, and adjust anti-lock brake system (ABS) speed sensors.	IR	PR

AREA 2: BRAKES--Priority Three (5)

Task	12	AD
A. Hydraulic System Diagnosis and Repair		
8. Inspect, test, and replace metering (hold-off), proportioning (balance), pressure differential, and combination valves.	P	R
9. Inspect, test, replace, and adjust height (load) sensing proportioning valve.	IR	PR
10. Inspect, test, and replace components of brake warning light system.	P	R
12. Flush hydraulic system.	P	
B. Drum Brake Diagnosis and Repair (NONE)		
C. Disc Brake Diagnosis and Repair		
9. Adjust calipers with integrated parking brake system.	P	PR
D. Power Assist Units Diagnosis and Repair		
4. Inspect and test hydro-boost system and accumulator for leaks and proper operation; determine necessary action.	P	R
E. Miscellaneous (Wheel Bearings, Parking Brakes, Electrical, Etc.) Diagnosis and Repair		
5. Check operation of parking brake indicator light system.	P	
F. Anti-lock Brake System		
6. Remove and install anti-lock brake system (ABS) electrical/electronic and hydraulic components.	I	P
8. Diagnose anti-lock brake system (ABS) braking concerns caused by vehicle modifications (tire size, curb height, final drive ratio, etc.).	I	P

AREA 3: ELECTRICAL/ELECTRONIC SYSTEMS—Priority One (20)

Task	12	AD
A. General Electrical System Diagnosis		
1. Use wiring diagrams during diagnosis of electrical circuit problems.	P	
3. Check voltage and voltage drop in electrical/electronic circuits using a digital multimeter (DMM); determine necessary action.	P	
4. Check current flow in electrical/electronic circuits and components using an ammeter; determine necessary action.	P	
5. Check continuity and resistances in electrical/electronic circuits and components with an ohmmeter; determine necessary action.	P	
7. Locate shorts, grounds, opens, and resistance problems in electrical/electronic circuits; determine necessary action.	P	
8. Measure and diagnose the cause(s) of abnormal key-off battery drain; determine necessary action.	P	
9. Inspect and test fusible links, circuit breakers, and fuses; determine necessary action.	P	
10. Inspect and test switches, connectors, relays, and wires of electrical/electronic circuits; perform necessary action.	P	
11. Repair wiring harnesses and connectors.	P	
12. Perform solder repair of electrical wiring.	P	
B. Battery Diagnosis and Service		
1. Perform battery state-of-charge test; determine needed service.	P	
2. Perform battery capacity test; determine needed service.	P	
6. Inspect and clean battery cables, connectors, clamps, and hold-downs; repair or replace as needed.	P	
7. Start a vehicle using jumper cables and a battery or auxiliary power supply according to manufacturers recommended specifications.	P	
C. Starting System Diagnosis and Repair		
1. Perform starter current draw tests; determine necessary action.	P	
2. Perform starter circuit voltage drop tests; determine necessary action.	P	
D. Charging System Diagnosis and Repair		
1. Perform charging system output test; determine necessary action.	P	
2. Diagnose charging system for the cause of undercharge, no-charge, and overcharge conditions.	P	
3. Inspect and adjust generator (alternator) drive belts; replace as needed.	P	
7. Perform charging circuit voltage drop tests; determine necessary action.	P	
E. Lighting Systems Diagnosis and Repair (NONE)		

Task	12	AD
F. Gauges, Warning Devices, and Driver Information Systems Diagnosis and Repair		
3. Diagnose the cause of incorrect operation of warning devices and other driver information systems; determine necessary action.	P	
G. Horn and Wiper/Washer Diagnosis and Repair (NONE)		
H. Accessories Diagnosis and Repair (NONE)		

AREA 3: ELECTRICAL/ELECTRONIC SYSTEMS—Priority Two (13)

Task	12	AD
A. General Electrical System Diagnosis		
2. Check electrical circuits with a test light; determine necessary action.	P	R
6. Check electrical circuits using jumper wires; determine necessary action.	P	R
B. Battery Diagnosis and Service		
3. Maintain or restore electronic memory functions.	P	R
4. Inspect, clean, fill, and replace battery.	P	PR
5. Perform slow/fast battery charge.	P	PR
C. Starting System Diagnosis and Repair		
3. Inspect and test starter relays and solenoids; replace as needed.	IR	PR
4. Remove and install starter.	P	
6. Inspect and test switches, connectors, and wires of starter control circuits; perform necessary action.	P	R
D. Charging System Diagnosis and Repair		
4. Inspect and test voltage regulator/regulating circuit; perform necessary action.	P	R
5. Remove inspect, and install generator (alternator).	P	PR
E. Lighting Systems Diagnosis and Repair		
1. Diagnose the cause of brighter than normal, intermittent, dim, or no light operation; determine necessary action.	P	PR
2. Inspect, replace, and aim headlights and bulbs.	P	
3. Inspect and diagnose incorrect turn signal or hazard light operation; perform necessary action.	P	PR
F. Gauges, Warning Devices, and Driver Information Systems Diagnosis and Repair		
1. Inspect and test gauges and gauge sending units for cause of intermittent, high, low, or no gauge readings; determine necessary action.	I	P
G. Horn and Wiper/Washer Diagnosis and Repair (NONE)		
H. Accessories Diagnosis and Repair		
1. Diagnose incorrect operation of motor-driven accessory circuits; determine necessary action.	I	P
5. Diagnose supplemental restraint system (SRS) concerns; determine necessary action. (Note: Follow manufacturer's safety procedures to prevent accidental deployment.)	I	PR

AREA 3: ELECTRICAL/ELECTRONIC SYSTEMS—Priority Three (6)

Task	12	AD
A. General Electrical System Diagnosis (NONE)		
B. Battery Diagnosis and Service (NONE)		
C. Starting System Diagnosis and Repair		
5. Perform starter bench tests; determine necessary action.	IR	PR
7. Disassemble, clean, inspect, and test starter components; replace as needed.	IR	PR
D. Charging System Diagnosis and Repair		
6. Disassemble generator (alternator), clean, inspect, and test components; determine necessary action.	IR	PR
E. Lighting Systems Diagnosis and Repair (NONE)		
F. Gauges, Warning Devices, and Driver Information Systems Diagnosis and Repair		
2. Inspect and test connectors, wires, and printed circuit boards of gauge circuits; determine necessary action.	I	P
4. Inspect and test sensors, connectors, and wires of electronic instrument circuits; determine necessary action.	I	P
G. Horn and Wiper/Washer Diagnosis and Repair		
1. Diagnose incorrect horn operation; perform necessary action.	P	R
2. Diagnose incorrect wiper operation; diagnose wiper speed control and park problems; perform necessary action.	IR	PR
3. Diagnose incorrect windshield washer operation; perform necessary action.	P	PR
H. Accessories Diagnosis and Repair		
2. Diagnose incorrect heated glass operation; determine necessary action.	P	PR
3. Diagnose incorrect electric lock operation; determine necessary action.	IR	PR
4. Diagnose incorrect operation of cruise control systems; repair as needed.	IR	PR
6. Diagnose radio static and weak, intermittent, or no radio reception; determine necessary action.	I	P

AREA 4: ENGINE PERFORMANCE—Priority One (26)

Task	12	AD
A. General Engine Diagnosis		
1. Interpret and verify concern; determine necessary action.	I	P
5. Perform engine absolute (vacuum/boost) manifold pressure tests; determine necessary action.	P	R
6. Perform cylinder power balance test; determine necessary action.	P	
7. Perform cylinder compression test; determine necessary action.	P	
8. Perform cylinder leakage test; determine necessary action.	P	
9. Diagnose engine mechanical, electrical, electronic, fuel, and ignition concerns with an oscilloscope and engine diagnostic equipment; determine necessary action.	I	P
10. Prepare 4 or 5 gas analyzer; inspect and prepare vehicle for test, and obtain exhaust readings; interpret readings, and determine necessary action.	I	P
B. Computerized Engine Controls Diagnosis and Repair		
1. Retrieve and record stored OBD I diagnostic trouble codes; clear codes.	P	R
3. Diagnose the causes of emissions or driveability concerns resulting from failure of computerized engine controls with stored diagnostic trouble codes.	I	P
4. Diagnose emissions or driveability concerns resulting from failure of computerized engine controls with no stored diagnostic trouble codes; determine necessary action.	I	P
6. Obtain and interpret digital multimeter (DMM) readings.	I	R
8. Locate and interpret vehicle and major component identification numbers (VIN, vehicle certification labels, and calibration decals).	P	
9. Inspect and test power and ground circuits and connections; service or replace as needed.	P	R

Task	12	AD
C. Ignition System Diagnosis and Repair		
1. Diagnose no-starting, driveability, and emissions concerns on vehicles with electronic ignition (EI/DIS) (distributorless) systems; determine necessary action.	<i>I</i>	P
2. Diagnose no-starting, driveability, and emissions concerns on vehicles with distributor ignition (DI) systems; determine necessary action.	<i>I</i>	P
7. Check and adjust (where applicable) ignition system timing and timing advance/retard.	P	
D. Fuel, Air Induction, and Exhaust Systems Diagnosis and Repair		
2. Diagnose hot or cold no-starting, hard starting, poor driveability, incorrect idle speed, poor idle, flooding, hesitation, surging, engine misfire, power loss, stalling, poor mileage, dieseling, and emissions problems on vehicles with injection-type fuel systems; determine necessary action.	<i>I</i>	P
6. Replace fuel filters.	P	
7. Inspect and test fuel pressure regulation system and components of injection-type fuel systems; perform necessary action.	<i>I</i>	P
16. Perform exhaust system back-pressure test; determine necessary action.	<i>I</i>	
E. Emissions Control Systems Diagnosis and Repair		
1. Positive Crankcase Ventilation		
1. Diagnose oil leaks, emissions, and driveability problems resulting from failure of the positive crankcase ventilation (PCV) system; determine necessary action.	<i>P</i>	R
2. Exhaust Gas Recirculation		
1. Diagnose emissions and driveability problems caused by failure of the exhaust gas recirculation (EGR) system; determine necessary action.	<i>I</i>	P
3. Exhaust Gas Treatment (NONE)		
4. Intake Air Temperature Controls (NONE)		
5. Early Fuel Evaporation (Intake Manifold Temperature) Controls (NONE)		
6. Evaporative Emissions Controls (NONE)		
F. Engine Related Service		
1. Adjust valves on engines with mechanical or hydraulic lifters.	<i>I</i>	
2. Verify correct camshaft timing; determine necessary action.	P	
3. Verify engine operating temperature; determine necessary action.	P	
4. Perform cooling system pressure tests; check coolant condition; inspect and test radiator, pressure cap, coolant recovery tank, and hoses; perform necessary action.	P	
5. Inspect and test thermostat, by-pass, and housing; perform necessary action.	P	

AREA 4: ENGINE PERFORMANCE—Priority Two (25)

Task	12	AD
A. General Engine Diagnosis		
2. Inspect engine assembly for fuel, oil, coolant, and other leaks; determine necessary action.	P	R
3. Diagnose unusual engine noise or vibration concerns; determine necessary action.	I	P
4. Diagnose unusual exhaust color, odor, and sound; determine necessary action.	I	P
B. Computerized Engine Controls Diagnosis and Repair		
5. Inspect and test computerized engine control system sensors, powertrain control module (PCM), actuators, and circuits; perform necessary action.	I	P
10. Practice recommended precautions when handling static sensitive devices.	P	R
11. Diagnose driveability and emissions problems resulting from failures of interrelated systems (cruise control, security alarms, suspension controls, traction controls, A/C, automatic transmissions, non-OEM-installed accessories, and similar systems); determine necessary action.	I	P
C. Ignition System Diagnosis and Repair		
3. Inspect and test ignition primary circuit wiring and components; perform necessary action.	P	R
5. Inspect and test ignition system secondary circuit wiring and components; perform necessary action.	I	P
6. Inspect and test ignition coil(s); perform necessary action.	P	R
8. Inspect and test ignition system pick-up sensor or triggering devices; perform necessary action.	IR	PR
9. Inspect and test ignition control module; perform necessary action.	IR	PR
D. Fuel, Air Induction, and Exhaust Systems Diagnosis and Repair		
3. Inspect fuel tank and fuel cap, fuel lines, fittings, and hoses, perform necessary action.	P	PR
4. Check fuel for contaminants and quality; determine necessary action.	I	P

Task	12	AD
5. Inspect and test mechanical and electrical fuel pumps and pump control systems; perform necessary action.	IR	PR
9. Remove, service, and install throttle body; adjust related linkages.	P	R
10. Inspect, test, and clean fuel injectors.	IR	PR
11. Inspect throttle body mounting plates, air induction and filtration system, intake manifold, and gaskets; perform necessary action.	P	R
12. Check idle speed and fuel mixture.	P	PR
14. Remove, inspect, and test vacuum and electrical circuits, components and connections of fuel system; perform necessary action.	I	P
15. Inspect exhaust manifold, exhaust pipes, muffler(s), catalytic converter(s), resonator(s), tail pipe(s), and heat shield(s); perform necessary action.	P	R
E. Emissions Control Systems Diagnosis and Repair		
1. Positive Crankcase Ventilation		
2. Inspect and test positive crankcase ventilation (PCV) filter/breather cap, valve, tubes, orifices, and hoses; perform necessary action.	P	R
2. Exhaust Gas Recirculation		
2. Inspect and test valve, valve manifold, and exhaust passages of exhaust gas recirculation (EGR) systems; perform necessary action.	IR	PR
3. Inspect and test vacuum/pressure controls, filters, and hoses of exhaust gas recirculation (EGR) systems; perform necessary action.	I	P
4. Inspect and test electrical/electronic sensors, controls, and wiring of exhaust gas recirculation (EGR) systems; perform necessary action.	I	P
3. Exhaust Gas Treatment		
1. Diagnose emissions and driveability problems resulting from failure of the secondary air injection and catalytic converter systems; determine necessary action.	I	PR
2. Inspect and test mechanical components of secondary air injection systems; perform necessary action.	I	PR
3. Inspect and test electrical/electronically-operated components and circuits of air injection systems; perform necessary action.	I	P
4. Inspect and test components of catalytic converter systems; perform necessary action.	IR	PR
4. Intake Air Temperature Controls (NONE)		
5. Early Fuel Evaporation (Intake Manifold Temperature) Controls (NONE)		
6. Evaporative Emissions Controls		
1. Diagnose emissions and driveability problems resulting from failure of evaporative emissions control system; determine necessary action.	I	P
2. Inspect and test components and hoses of evaporative emissions control system; perform necessary action.	IR	PR

Task	12	AD
F. Engine Related Service		
6. Inspect and test mechanical/electrical fans, fan clutch, fan shroud/ducting, air dams, and fan control devices; perform necessary action.	IR	PR

AREA 4: ENGINE PERFORMANCE—Priority Three (6)

Task	12	AD
A. General Engine Diagnosis (NONE)		
B. Computerized Engine Controls Diagnosis and Repair		
2. Retrieve and record stored OBD II diagnostic trouble codes; clear codes.	P	R
7. Access and use electronic service information (ESI).	P	R
C. Ignition System Diagnosis and Repair		
4. Inspect and test distributor; perform necessary action.	P	PR
D. Fuel, Air Induction, and Exhaust Systems Diagnosis and Repair		
1. Diagnose hot or cold no-starting, hard starting, poor driveability, incorrect idle speed, poor idle, flooding, hesitation, surging, engine misfire, power loss, stalling, poor mileage, dieseling, and emissions problems on vehicles with carburetor-type fuel systems; determine necessary action.	I	P
8. Inspect and test cold enrichment system and components; perform necessary action.	I	P
13. Adjust (carburetor) idle speed and fuel mixture.	I	P
17. Test the operation of turbocharger/supercharger systems; determine necessary action.	I	P
E. Emissions Control Systems Diagnosis and Repair		
1. Positive Crankcase Ventilation (NONE)		
2. Exhaust Gas Recirculation (NONE)		
3. Exhaust Gas Treatment (NONE)		
4. Intake Air Temperature Controls		
1. Diagnose emissions and driveability problems resulting from failure of the intake air temperature control system; determine necessary action.	I	PR
2. Inspect and test components of intake air temperature control system; perform necessary action.	I	PR
5. Early Fuel Evaporation (Intake Manifold Temperature) Controls		
1. Diagnose emissions and driveability problems resulting from failure of early fuel evaporation control system; determine necessary action.	I	PR
2. Inspect and test components of early fuel evaporation control system; perform necessary action.	I	PR
6. Evaporative Emissions Controls (NONE)		
F. Engine Related Service (NONE)		

Certification in the following four areas is not required to meet minimum ASE requirements (1999 Standards) or the new Ohio Tech Prep Standards.

1. Engine Repair
2. Automatic Transmission and Transaxle
3. Manual Drive Train and Axles
4. Heating and Air Conditioning

In Ohio, participation in any of the above certification programs is strictly optional. However, if a school pursues certification in any of these areas, then the competencies listed in the applicable section of the following technical competency profiles must be taught to the depth and at the level specified.

In addition, the Automotive Technical Competency Releveling Advisory Panel requires that the asterisk (*) competencies in the following TCPs be covered in any Automotive Tech Prep program in Ohio (even if certification is not pursued in these areas).

AREA 5: ENGINE REPAIR--Priority One (15)

Task	12	AD
C. General Engine Diagnosis; Removal and Reinstallation (R & R)		
1. Verify and interpret engine concern; determine necessary action.	IR	PR
5. Perform engine vacuum tests; determine necessary action.	P	
6. Perform cylinder power balance tests; determine necessary action.	P	
7. Perform cylinder compression tests; determine necessary action.	P	
8. Perform cylinder leakage tests; determine necessary action.	P	
B. Cylinder Head and Valve Train Diagnosis and Repair		
13. Adjust valves (mechanical or hydraulic lifters).	P	
* 15. Inspect and replace timing belt(s), overhead camdrive sprockets, and tensioners; check belt tension; adjust as necessary.	P	
18. Verify camshaft(s) timing according to manufacturer's specifications and procedure.	P	
C. Engine Block Assembly Diagnosis and Repair		
* 3. Inspect internal and external threads; restore as needed (includes installing thread inserts).	P	
6. Deglaze and clean cylinder walls.	P	
16. Prime engine lubrication system.	IR	PR
D. Lubrication and Cooling Systems Diagnosis and Repair		
* 1. Perform oil pressure tests; determine necessary action.	P	
3. Perform cooling system, cap, and recovery system tests (pressure, combustion leakage, and temperature); determine necessary action.	P	
* 4. Inspect, replace, and adjust drive belts, tensioners, and pulleys.	P	
* 7. Test coolant; drain and recover coolant; flush and refill cooling system with recommended coolant; bleed air as required.	P	
* 13. Perform oil and filter change.	P	

AREA 5: ENGINE REPAIR– Priority Two (18)

Task	12	AD
A. General Engine Diagnosis; Removal and Reinstallation (R & R)		
* 2. Inspect engine assembly for fuel, oil, coolant, and other leaks; determine necessary action.	P	R
B. Cylinder Head and Valve Train Diagnosis and Repair		
1. Remove cylinder head(s); visually inspect cylinder head(s) for cracks; check gasket surface areas for warpage and leakage; check passage condition.	P	R
2. Install cylinder heads and gaskets; tighten according to manufacturer's specifications and procedures.	P	R
4. Inspect valve spring retainers, locks, and valve grooves.	P	PR
7. Resurface valves; perform necessary action.	IR	PR
8. Resurface valve seats; perform necessary action.	IR	PR
10. Check valve spring assembled height and valve stem height; service valve and spring assemblies as needed.	IR	PR
11. Inspect pushrods, rocker arms, rocker arm pivots and shafts for wear, bending, cracks, looseness, and blocked oil passages (orifices); perform necessary action.	IR	PR
12. Inspect hydraulic or mechanical lifters; replace as needed.	IR	PR
14. Inspect camshaft drives (including gear wear and backlash, sprocket and chain wear); replace as necessary.	IR	PR
C. Engine Block Assembly Diagnosis and Repair		
* 1. Inspect and replace pans, covers, gaskets, and seals.	P	PR
2. Inspect engine block for visible cracks, passage condition, core and gallery plug condition, and surface warpage; determine necessary action.	P	PR
5. Inspect and measure cylinder walls for damage and wear; determine necessary action.	IR	PR
9. Inspect and measure main and connecting rod bearings for damage, clearance, and end play; determine necessary action (includes the proper selection of bearings).	IR	PR
11. Inspect, measure, and service pistons and pins; determine necessary action.	IR	PR
12. Inspect, measure, and install piston rings.	IR	PR
* 14. Reassemble engine components using correct gaskets and sealants.	P	R
D. Lubrication and Cooling Systems Diagnosis and Repair		
5. Inspect and replace engine cooling and heater system hoses.	P	PR
6. Inspect, test, and replace thermostat and housing.	P	PR
* 8. Inspect, test, remove, and replace water pump.	IR	PR
* 9. Remove and replace radiator.	IR	PR
* 10. Inspect, and test fan(s) (electrical or mechanical), fan clutch, fan shroud, and air dams.	IR	PR
* 12. Inspect, test, and replace oil temperature and pressure switches and sensors.	IR	PR

AREA 5: ENGINE REPAIR--Priority Three (10)

Task	12	AD
A. General Engine Diagnosis; Removal and Reinstallation (R & R)		
3. Diagnose engine noises and vibrations; determine necessary action.	IR	PR
4. Diagnose the cause of excessive oil consumption, unusual engine exhaust color, odor, and sound; determine necessary action.	IR	PR
9. Remove engine (front-wheel drive); prepare for disassembly.	IR	PR
10. Reinstall engine (front-wheel drive).	IR	PR
11. Remove engine (rear-wheel drive); prepare for disassembly.	IR	PR
12. Reinstall engine (rear-wheel drive).	IR	PR
B. Cylinder Head and Valve Train Diagnosis and Repair		
3. Inspect and test valve springs for squareness, pressure, and free height comparison; replace as needed.	I	P
5. Replace valve stem seals.	IR	PR
6. Inspect valve guides for wear; check valve guide height and stem-to-guide clearance.	IR	PR
9. Check valve face-to-seat contact and valve seat concentricity (runout); service seats and valves as needed.	IR	PR
16. Inspect camshaft for runout, journal wear and lobe wear.	IR	PR
17. Inspect and measure camshaft bearing for wear, damage, out-of-round, and alignment; determine necessary action.	IR	PR
C. Engine Block Assembly Diagnosis and Repair		
4. Remove cylinder wall ridges.	P	R
7. Inspect and measure crankshaft bearings for wear, damage, out-of-round, and alignment; determine necessary action.	IR	PR
8. Inspect crankshaft for surface cracks and journal damage; check oil passage condition; measure journal wear; determine necessary action.	IR	PR
10. Identify piston and bearing wear patterns that indicate connecting rod alignment and main bearing bore problems; inspect rod alignment and bearing bore condition.	IR	PR
13. Inspect, repair or replace crankshaft vibration damper (harmonic balancer).	P	PR
15. Inspect auxiliary (balance, intermediate, idler, counterbalance or silencer) shaft(s); inspect shaft(s) and support bearing for damage and wear; determine necessary action; reinstall and time.	I	P
D. Lubrication and Cooling Systems Diagnosis and Repair		
2. Inspect oil pump gears or rotors, housing, pressure relief devices, and pump drive; perform necessary action.	IR	PR
11. Inspect auxiliary oil coolers; replace as needed.	P	PR

AREA 6: AUTOMATIC TRANSMISSION AND TRANSAXLE—Priority One

Task	12	AD
A. General Transmission and Transaxle Diagnosis		
1. Identify and interpret transmission concern; assure proper engine operation; determine necessary action.	I	P
* 2. Diagnose unusual fluid usage, level, and condition concerns; determine necessary action.	I	P
3. Perform pressure tests; determine necessary action.		P
5. Diagnose electronic, mechanical, hydraulic, vacuum control system concerns; determine necessary action.	I	P
B. Transmission and Transaxle Maintenance and Adjustment		
* 1. Inspect, adjust or replace throttle (TV) linkages or cables, check gear select indicator (as applicable).	I	P
* 2. Service transmission; perform visual inspection; replace fluids and filters.	P	R
C. In-Vehicle Transmission and Transaxle Repair		
* 5. Inspect, leak test, flush, and replace cooler, lines, and fittings.	P	R
7. Inspect and test, adjust, repair or replace transmission related electrical and electronic components (includes computers, solenoids, sensors, relays, switches, and harnesses).	I	P
D. Off-Vehicle Transmission and Transaxle Repair		
9. Removal, Disassembly, and Reinstallation		
3. Disassemble, clean, and inspect transmission/transaxle.		P
7. Assemble transmission/transaxle.		P
10. Oil Pump and Converter		
4. Check torque converter and transmission cooling system for contamination.		P
11. Gear Train, Shafts, Bushings and Case		
1. Measure endplay or preload; determine necessary action.		P
12. Friction and Reaction Units		
2. Measure clutch pack clearance; adjust as needed.		P
3. Air test operation of clutch and servo assemblies.		P

AREA 6: AUTOMATIC TRANSMISSION AND TRANSAXLE—Priority Two

Task	12	AD
A. General Transmission and Transaxle Diagnosis		
4. Perform lock-up converter system tests; determine necessary action.		P
B. Transmission and Transaxle Maintenance and Adjustment (NONE)		
C. In-Vehicle Transmission and Transaxle Repair		
* 3. Inspect and replace external seals and gaskets.	P	R
D. Off-Vehicle Transmission and Transaxle Repair		
1. Removal, Disassembly, and Reinstallation		
1. Remove and reinstall transmission and torque converter (rear-wheel drive).	IR	P
2. Remove and reinstall transaxle and torque converter assembly.	IR	P
4. Inspect, measure, clean, and replace valve body (includes surfaces and bores, springs, valves, sleeves, retainers, brackets, check-balls, screens, spacers, and gaskets), and torque valve body bolts.		P
2. Oil Pump and Converter		
1. Inspect converter flex plate, attaching parts, pilot, pump drive, and seal areas.	IR	P
2. Measure torque converter endplay and check for interference; check stator clutch.		P
3. Gear Train, Shafts, Bushings and Case		
2. Inspect, measure, and replace thrust washers and bearings.		P
3. Inspect oil delivery seal rings, ring grooves, and sealing surface areas.		P
4. Inspect bushings; replace as needed.		P
5. Inspect and measure planetary gear assembly (includes sun, ring gear, thrust washers, planetary gears, and carrier assembly); replace as needed.		P
6. Inspect case bores, passages, bushings, vents, and mating surfaces; determine necessary action.		P
7. Inspect transaxle drive, link chains, sprockets, gears, bearings, and bushings; perform necessary action.		P
8. Inspect, measure, repair, adjust or replace transaxle final drive components.		P
4. Friction and Reaction Units		
1. Inspect clutch drum, piston, check-balls, springs, retainers, seals, and friction and pressure plates; replace as needed.		P
4. Inspect roller and sprag clutch, races, rollers, sprags, springs, cages, and retainers; replace as needed.		P

AREA 6: AUTOMATIC TRANSMISSION AND TRANSAXLE—Priority Three

Task	12	AD
A. General Transmission and Transaxle Diagnosis		
6. Diagnose noise and vibration concerns; determine necessary action.		P
B. Transmission and Transaxle Maintenance and Adjustment (NONE)		
C. In-Vehicle Transmission and Transaxle Repair		
1. Inspect, adjust or replace (as applicable) vacuum modulator; inspect and repair or replace lines and hoses.	IR	P
2. Inspect, repair, and replace governor assembly.	I	P
4. Inspect extension housing, bushings and seals; perform necessary action.	IR	P
6. Inspect and replace speedometer drive gear, driven gear, vehicle speed sensor (VSS), and retainers.	IR	P
* 8. Inspect, replace, and align powertrain mounts.	P	PR
D. Off-Vehicle Transmission and Transaxle Repair		
1. Removal, Disassembly, and Reinstallation		
5. Inspect servo bore, piston, seals, pin, spring, and retainers; determine necessary action.		P
6. Inspect accumulator bore, piston, seals, spring, and retainer; determine necessary action.		P
2. Oil Pump and Converter		
3. Inspect, measure, and replace oil pump assembly and components.		P
3. Gear Train, Shafts, Bushings and Case		
9. Inspect and reinstall parking pawl, shaft, spring, and retainer; determine necessary action.		P
4. Friction and Reaction Units		
5. Inspect bands and drums; adjust or replace as needed.		P

AREA 7: MANUAL DRIVE TRAIN AND AXLES—Priority One

Task	12	AD
A. Clutch Diagnosis and Repair		
1. Diagnose clutch noise, binding, slippage, pulsation, and chatter; determine necessary action.	I	P
2. Inspect clutch pedal linkage, cables, automatic adjuster mechanisms, brackets, bushings, pivots, and springs; perform necessary action.	I	P
3. Inspect hydraulic clutch slave and master cylinders, lines, and hoses; perform necessary action.	I	P
4. Inspect release (throw-out) bearing, lever, and pivot; perform necessary action.	I	P
5. Inspect and replace clutch pressure plate assembly and clutch disc.	IR	P
6. Inspect, remove or replace crankshaft pilot bearing or bushing (as applicable).	IR	P
7. Inspect flywheel and ring gear for wear and cracks, measure runout; determine necessary action.	IR	P
B. Transmission/Transaxle Diagnosis and Repair		
10. Measure endplay or preload (shim or spacer selection procedure) on transmission/transaxle shafts; perform necessary action.		P
16. Inspect, test, and replace transmission/transaxle sensors and switches.	I	P
C. Drive Shaft and Half Shaft, Universal and Constant-Velocity (CV) Joint Diagnosis and Repair		
* 4. Inspect, service, and replace shafts, yokes, boots, and CV joints.	P	PR
D. Drive Axle Diagnosis and Repair		
7. Ring and Pinion Gears and Differential Case Assembly		
7. Measure and adjust drive pinion bearing preload.	I	P
9. Check ring and pinion tooth contact patterns; perform necessary action.	I	P
8. Limited Slip Differential (NONE)		
9. Drive Axle Shaft		
* 3. Remove and replace drive axle shafts.	P	PR
E. Four-wheel Drive/All-wheel Drive Component Diagnosis and Repair (NONE)		

AREA 7: MANUAL DRIVE TRAIN AND AXLES—Priority Two

Task	12	AD
A. Clutch Diagnosis and Repair (NONE)		
B. Transmission/Transaxle Diagnosis and Repair		
1. Remove and reinstall transmission/transaxle.	IR	PR
2. Disassemble, clean, and reassemble transmission/transaxle components.	I	PR
7. Inspect and replace gaskets, seals, and sealants; inspect sealing surfaces.	IR	PR
9. Inspect, adjust, and reinstall shift cover, forks, levers, grommets, shafts, sleeves, detent mechanism, interlocks, and springs.	I	PR
11. Inspect and reinstall synchronizer hub, sleeve, keys (inserts), springs, and blocking rings.	I	PR
12. Inspect and reinstall speedometer drive gear, driven gear, vehicle speed sensor (VSS), and retainers.	IR	PR
14. Remove, inspect, measure, adjust, and reinstall transaxle final drive pinion gears (spiders), shaft, side gears, side bearings, thrust washers, and case assembly.	I	PR
C. Drive Shaft and Half Shaft, Universal and Constant-Velocity (CV) Joint Diagnosis and Repair		
1. Diagnose constant-velocity (CV) joint noise and vibration concerns; determine necessary action.	IR	PR
2. Diagnose universal joint noise and vibration concerns; perform necessary action.	IR	PR
3. Replace front wheel drive (FWD) front wheel bearing.	I	PR
D. Drive Axle Diagnosis and Repair		
1. Ring and Pinion Gears and Differential Case Assembly		
1. Diagnose noise and vibration concerns; determine necessary action.	I	PR
* 2. Diagnose fluid leakage concerns; determine necessary action.	P	R
3. Inspect and replace companion flange and pinion seal; measure companion flange runout.	I	PR
4. Inspect ring gear and measure runout; determine necessary action.	I	PR
5. Remove, inspect, and reinstall drive pinion and ring gear, spacers, sleeves, and bearings.	I	PR
6. Measure and adjust drive pinion depth.	I	PR
8. Measure and adjust side bearing preload and ring and pinion gear total backlash and backlash variation on a differential carrier assembly (threaded cup or shim types).	I	PR
10. Disassemble, inspect, measure, and adjust or replace differential pinion gears (spiders), shaft side gears, side bearings, thrust washers, and case.	I	PR
11. Reassemble and reinstall differential case assembly; measure runout; determine necessary action.	I	PR

Task	12	AD
2. Limited Slip Differential		
* 2. Inspect and flush differential housing; refill with correct lubricant.	P	PR
3. Drive Axle Shaft		
1. Diagnose drive axle shafts, bearings, and seals for noise, vibration, and fluid leakage concerns; determine necessary action.	I	PR
4. Inspect and replace drive axle shaft seals, bearings, and retainers.	I	PR
5. Measure drive axle flange runout and shaft endplay; determine necessary action.	I	PR
E. Four-wheel Drive/All-wheel Drive Component Diagnosis and Repair (NONE)		

AREA 7: MANUAL DRIVE TRAIN AND AXLES—Priority Three

Task	12	AD
A. Clutch Diagnosis and Repair		
8. Inspect engine block, clutch (bell) housing, and transmission/transaxle case mating surfaces; determine necessary action.	IR	PR
9. Measure flywheel-to-block runout and crankshaft endplay; determine necessary action.	IR	PR
B. Transmission/Transaxle Diagnosis and Repair		
3. Inspect transmission/transaxle case, extension housing, case mating surfaces, bores, bushings, and vents; perform necessary action.		P
4. Diagnose noise, hard shifting, jumping out of gear, and fluid leakage concerns; determine necessary action.	I	PR
5. Inspect, adjust, and reinstall shift linkages, brackets, bushings, cables, pivots, and levers.	IR	PR
6. Inspect and reinstall powertrain mounts.	P	PR
8. Remove and replace transaxle final drive.	I	PR
13. Diagnose transaxle final drive assembly noise and vibration concerns; determine necessary action.		P
15. Inspect lubrication devices (oil pump or slingers); perform necessary action.		P
C. Drive Shaft and Half Shaft, Universal and Constant-Velocity (CV) Joint Diagnosis and Repair		
5. Inspect, service, and replace shaft center support bearings.	IR	P
6. Check shaft balance; measure shaft runout; measure and adjust driveline angles.	I	P
D. Drive Axle Diagnosis and Repair		
1. Ring and Pinion Gears and Differential Case Assembly (NONE)		
2. Limited Slip Differential		
1. Diagnose noise, slippage, and chatter concerns; determine necessary action.	I	PR
3. Inspect and reinstall clutch (cone or plate) components.		P
4. Measure rotating torque; determine necessary action.		P
3. Drive Axle Shaft		
* 2. Inspect and replace drive axle shaft wheel studs.	P	PR
E. Four-wheel Drive/All-wheel Drive Component Diagnosis and Repair		
1. Diagnose noise, vibration, and unusual steering concerns; determine necessary action.		P
2. Inspect, adjust, and repair shifting controls (mechanical, electrical, and vacuum), bushings, mounts, levers, and brackets.		P
3. Remove and reinstall transfer case.		P
4. Disassemble, service, and reassemble transfer case and components.		P
5. Inspect front-wheel bearings and locking hubs; perform necessary action.		P
* 6. Check drive assembly seals and vents; check lube level.	P	R
7. Diagnose test, adjust, and replace electrical/electronic components of four-wheel drive systems.		P

AREA 8: HEATING AND AIR CONDITIONING—Priority One (15)

Task	12	AD
A. A/C System Diagnosis and Repair		
* 2. Identify refrigerant type; conduct a performance test of the A/C system; determine necessary action.	I	P
* 3. Leak test A/C system; determine necessary action.	I	P
B. Refrigeration System Component Diagnosis and Repair		
1. Compressor and Clutch (NONE)		
4. Evaporator, Condenser, and Related Components		
* 3. Inspect A/C condenser for airflow restrictions; perform necessary action.	P	R
C. Heating, Ventilation, and Engine Cooling Systems Diagnosis and Repair		
2. Perform cooling system, cap, and recovery system tests (pressure, combustion leakage, and temperature); determine necessary action.	P	
* 3. Inspect engine cooling and heater system hoses and belts; perform necessary action.	P	
4. Inspect, test, and replace thermostat and housing.	P	
5. Determine coolant condition; drain and recover coolant.	P	
6. Flush system; refill system with recommended coolant; bleed system.	P	
7. Inspect and test fan, fan clutch (electrical and mechanical), fan shroud, and air dams; perform necessary action.	P	PR
8. Inspect and test electrical fan control system and circuits.	I	P
D. Operating Systems and Related Controls Diagnosis and Repair (NONE)		
E. Refrigerant Recovery, Recycling, and Handling		
* 1. Verify correct operation and maintenance of refrigerant handling equipment.	P	
* 2. Identify (by label application or use of a refrigerant identifier) and recover A/C system refrigerant.	P	
* 3. Recycle refrigerant.	P	
* 4. Label and store refrigerant.	P	

Task	12	AD
* 5. Test recycled refrigerant for non-condensable gases.	P	
6. Evacuate and charge A/C system.	P	

AREA 8: HEATING AND AIR CONDITIONING—Priority Two (12)

Task	12	AD
A. A/C System Diagnosis and Repair		
1. Diagnose unusual operating noises in the A/C system; determine necessary action.	I	PR
4. Inspect the condition of discharged oil; determine necessary action.	I	P
5. Select oil type; measure, and add oil to the A/C system as needed.	P	PR
B. Refrigeration System Component Diagnosis and Repair		
1. Compressor and Clutch		
1. Diagnose A/C system conditions that cause the protection devices (pressure, thermal, and PCM) to interrupt system operation; determine necessary action.	I	P
* 2. Inspect A/C compressor drive belts; replace and adjust as needed.	P	R
3. Inspect, test, and replace A/C compressor clutch components or assembly.	P	R
4. Remove and replace A/C compressor and mountings.	P	R
2. Evaporator, Condenser, and Related Components		
2. Remove and inspect A/C system mufflers, hoses, lines, fittings, o-rings, seals, and service valves; perform necessary action.	P	R
4. Remove and install receiver/drier or accumulator/drier.	P	R
5. Remove and install expansion valve or orifice (expansion) tube.	P	R
C. Heating, Ventilation, and Engine Cooling Systems Diagnosis and Repair		
1. Diagnose temperature control problems in the heater/ventilation system; determine necessary action.	IR	PR
9. Inspect and test heater control valve(s); perform necessary action.	P	R
D. Operating Systems and Related Controls Diagnosis and Repair		
1. Diagnose failures in the electrical controls of heating, ventilation, and A/C (HVAC) systems; determine necessary action.	IR	PR
2. Inspect and test A/C-heater blower, motors, resistors, switches, relays, wiring, and protection devices; perform necessary action.	IR	PR
4. Diagnose failures in the vacuum and mechanical components and controls of the heating, ventilation, and A/C (HVAC) system; determine necessary action.	IR	PR
E. Refrigerant Recovery, Recycling, and Handling (NONE)		

AREA 8: HEATING AND AIR CONDITIONING—Priority Three (4)

Task	12	AD
A. A/C System Diagnosis and Repair (NONE)		
B. Refrigeration System Component Diagnosis and Repair		
1. Compressor and Clutch (NONE)		
2. Evaporator, Condenser, and Related Components		
1. Determine need for A/C system filter; perform necessary action.	P	PR
6. Inspect evaporator housing water drain; perform necessary action.	P	R
C. Heating, Ventilation, and Engine Cooling Systems Diagnosis and Repair (NONE)		
D. Operating Systems and Related Controls Diagnosis and Repair		
3. Test A/C compressor load cut-off systems; determine necessary action.	I	P
5. Inspect and test A/C-heater control panel assembly; determine necessary action.	IR	PR
6. Inspect and test A/C-heater control cables and linkages; perform necessary action.	IR	PR
7. Inspect and test A/C-heater ducts, doors, hoses, and outlets; perform necessary action.	IR	PR
8. Check operation of automatic and semi-automatic heating, ventilation, and air-conditioning (HVAC) control systems; determine necessary action.	I	IR
E. Refrigerant Recovery, Recycling, and Handling (NONE)		

Unit 1: Quality Assurance

BIL: Essential

AC:

EDU:	12	AD
	P	R

Competency 1.1: Demonstrate knowledge of quality assurance

Competency Builders:

Explain changes brought about by quality leaders in the world

Define quality terms

Define quality functions

Identify features of quality planning

Explain the relationship among organizational structures, policies, procedures, and quality assurance

Explain importance of internal and external customers

Describe successful efforts by industry to improve quality and/or reduce costs

Differentiate between prevention and detection

BIL: Essential

AC:

EDU:	12	AD
	I	P

Competency 1.2: Demonstrate knowledge of quality cost implications

Competency Builders:

Identify cost/quality objectives

Classify costs (i.e., direct and indirect, fixed and variable, methods and standards)

Classify quality costs (i.e., prevention, evaluation, pre-delivery failure, post-delivery failure)

Define product liability

Interpret quality cost reports

Explain consumerism and liability prevention

Define safety terms of product
 Identify safety responsibility within organization
 Differentiate between expressed and implied warranty
 Differentiate between warranty and product liability
 Explain how warranties are part of contract law
 List questions that would need answering in liability claim

BIL: Essential
AC:

EDU:	12	AD
	I	P

Competency 1.3: Demonstrate knowledge of providing a quality service

Competency Builders:

Associate customer satisfaction with service characteristics (e.g., usefulness, price, operation, life, reliability, safety, cost of operation)
 Identify steps in service design (e.g., brainstorming, thumbnail sketches, rendering)
 Define reliability factors (e.g., cost, human, producibility)
 Identify ways reliability is achieved (e.g., maintainability, good design, design simplification, design redundancy)
 Explain the relationship of maintainability to reliability
 Define failure
 Explain the role of testing and reliability
 Define value performance
 Define quality objectives
 Identify cost components as they relate to quality objectives
 Classify quality costs (i.e., preventive, evaluation, pre-delivery failures, post-delivery failures)

BIL: Essential
AC:

EDU:	12	AD
	P	R

Competency 1.4: Explain importance of interdepartmental relationships to quality assurance

Competency Builders:

Explain need for everyone's commitment in assuring quality

Explain phrase "Everyone is a customer/supplier"

Define quality improvement team models

Explain the importance of top management's support of quality

Explain project selection

Explain project implementation

Explain project evaluation

Explain continuing improvement

Unit 2: Technical Recording and Reporting

BIL: Essential

AC:

EDU:	12	AD
	P	R

Competency 2.1: Demonstrate proficiency in technical recording

Competency Builders:

Describe various documentation procedures

Interpret specifications or drawings

Observe process

Ask open-ended questions

Record process (e.g., flowchart, step-by-step)

Identify parameters

Record accurate, truthful data

Maintain test logs

Compile cumulative references notebook/record

Measure appropriate parameters

Draft preventative maintenance

Apply calibration procedures

BIL: Essential

AC:

EDU:	12	AD
	P	R

Competency 2.2: Demonstrate proficiency in technical reporting

Competency Builders:

Use data books and cross reference/technical manuals

Compose technical memoranda

Identify type of report or format needed

Use appropriate format

Compile relevant data
Design charts and graphs
Analyze data
Draw conclusions
Explain analytical methods used
Outline reports
Present reports

Unit 3: Workplace Safety

BIL: Essential

AC:

EDU:	12	AD
	P	R

Competency 3.1: Apply general safety precautions

Competency Builders:

Identify local, state, and federal regulatory agencies

Identify personal protective wear and equipment

Identify visual controls (e.g., monitors, read outs)

Identify auditory controls

Identify common sense housekeeping

Interpret hazardous materials notices on containers

Use personal protective wear and equipment

Apply personal safety rules and procedures

Apply workplace organization (e.g., housekeeping)

Apply applicable electrical, mechanical, steam, hydraulic, and pneumatic safety rules and procedures

Apply fire safety rules and procedures

Apply hazardous wastes rules and procedures

Apply first aid

Locate MSDS

Perform lockout and tagout

Recycle scrap metal, chips, shavings, coolants, colvents, trash, and waste materials

Apply common sense housekeeping

Use preventative maintenance checklists

BIL: Essential
AC:

EDU:	12	AD
	P	PR

Competency 3.2: Demonstrate knowledge of safety and workplace hazards

Competency Builders:

Describe corrective procedures for unsafe conditions

Identify types of potential level of workplace hazards (e.g., physical hazards, fire, chemicals, noise, ionizing radiation, ultraviolet, temperature extremes, ergonomics, biological hazards)

Identify safety materials/equipment (e.g., absorbant socks, oil dry)

Interpret Material Safety Data Sheets (MSDS)

Explain purpose(s) of NEC and NFPA

Identify purpose of emergency evacuation routes, master switch and lockout locations, and safety color coding systems

Identify roles of industrial hygienists, safety professionals, occupational physicians, and occupational nurses

Describe methods of evaluating potential hazards (e.g., visual analysis)

Describe methods of correcting potential hazards

Describe various types of toxicity (e.g., chronic, immediate)

Identify need for reporting accidents

Explain precautions required when using toxic or flammable materials

Define confined space and related requirements

BIL: Essential

AC:

EDU:	12	AD
	P	PR

Competency 3.3: Explain purpose of industrial pollution control systems

Competency Builders:

Describe types of air, water, solid waste, and noise pollution

Explain purpose of air pollution control systems

Explain purpose of water pollution control systems

Explain purpose of solid waste pollution control systems

Explain purpose of noise pollution control systems

Explain basic philosophy of “right to know” legislation

Explain purpose(s) of EPA

Identify “costs” of industrial pollution control (i.e., dollars vs. impact to environment)

Describe ethics of environmental issues

BIL: Essential

AC:

EDU:	12	AD
	P	PR

Competency 3.4: Demonstrate knowledge of ergonomics

Competency Builders:

Define ergonomics

Define risk factor

Define maximum permissible limit (MPL) and action limit (AL) for lifting

Define cumulative trauma disorder

Minimize extreme joint movement

Minimize use of excessive muscle force

Minimize repetitive tasks

Minimize mechanical stresses (e.g., sharp edges, heat, cold, hard surfaces, weights, vibration)

Minimize awkward body positions

Explain use of rest pauses

Explain need for mats and footrest for standing jobs

Explain need for appropriate working heights of chairs, stools, workbenches, and equipment

Explain need for adequate lighting

Unit 4: Management and Supervision

BIL: Essential

AC:

EDU:	12	AD
	P	R

Competency 4.1: Maintain a safe working environment

Competency Builders:

Demonstrate knowledge of the relationship between health, safety, and productivity

Identify health and safety standards established by government agencies

Access needed safety information using company and manufacturers' references (e.g., procedural manuals, documentation, standards, and flowcharts)

Establish preventive measure for dealing with the main causes of accidents in the facility

Establish preventive measures for dealing with the main causes of health problems in the facility

Establish preventive measures for dealing with violations of personnel security

Ensure compliance with government and/or company rules and regulations related to health and safety

Ensure maintenance of a clean work area

Perform safety audits and inspections

Solve safety problems using problem solving, decision-making, and critical thinking strategies

BIL: Essential

AC:

EDU:	12	AD
	P	R

Competency 4.2: Guide progress in assigned areas of responsibility/accountability

Competency Builders:

Set short- and long-term goals for assigned areas of responsibility/accountability

Demonstrate commitment to established goals and vision

Obtain support for goals

Provide support for goals

Monitor goal achievement

Adjust goals

Communicate goal achievement

Provide recognition for goal achievement

BIL: Recommended

AC:

EDU:	12	AD
	I	I

Competency 4.3: Perform staffing functions**Competency Builders:**

Develop plans and procedures for identifying staffing needs

Identify staffing needs in accordance with plans

Develop job descriptions

Develop hiring and promotion policies and procedures in compliance with state and federal employment laws

Establish guidelines for selecting the most qualified person for a specific position

Comply with state and federal employment laws and company hiring policies and procedures

Identify resources for locating candidates

Recruit candidates

Identify most appropriate candidates for position in accordance with established guidelines

Interview candidates for position

Follow up on information provided on job applications

Recommend or select applicants for employment

Orient new employees

Maintain personnel records

Comply with labor contracts

Comply with Workers' Compensation guidelines

Provide for unconventional work schedules (e.g., flextime, shared positions)
Identify additional or alternative employee benefits that the company might consider furnishing to employees

BIL: Recommended

AC:

EDU:	12	AD
	I	PR

Competency 4.4: Manage employee performance

Competency Builders:

Apply management/leadership style appropriate for situation

Clarify roles and relationships using organizational charts

Communicate performance expectations

Clarify company policies and procedures

Create/maintain an environment supportive of productivity

Establish office procedures

Maintain office procedure manual(s)

Monitor employee performance

Maintain performance records

Document personnel issues

Evaluate employee performance

Provide employees with constructive criticism and feedback

Counsel employees

Discipline employees

Make recommendations based on employee performance (e.g., transfer, promotion, or dismissal)

Manage the change process (e.g., for right-sizing, technological updating, globalization, retraining)

Adhere to company policies and federal laws governing discrimination and harassment

Demonstrate sensitivity to diversity, including differences in gender, culture, race, language, physical and mental challenges, and family structures

Apply knowledge of motivational theory in selecting management techniques

BIL: Recommended
AC:

EDU:	12	AD
	I	IR

Competency 4.5: Perform strategic planning functions

Competency Builders:

Guide the planning process using problem-solving, decision-making, and critical thinking strategies

Analyze needs

Secure needed information through research

Develop goals and objectives

Prioritize goals and objectives

Develop action plan for achieving objectives

Project trends and outcomes using forecasting techniques

Prepare budgets

Analyze budgets

Develop strategic plan

BIL: Recommended
AC:

EDU:	12	AD
	I	R

Competency 4.6: Perform routine management functions

Competency Builders:

Guide the management process using problem-solving, decision-making, and critical thinking strategies

Develop management objectives

Conduct task analyses

Create/maintain organizational and/or departmental charts

Maintain procedure manuals

Solve space utilization problems using math and problem-solving skills
 Follow the chain of command
 Maintain confidentiality
 Clarify company policies and procedures
 Communicate cost-containment factors
 Monitor budget activity
 Prepare managerial reports
 Analyze daily production reports
 Represent the organization to the public

BIL: Recommended
AC:

EDU:	12	AD
	I	R

Competency 4.7: Manage work flow and operations

Competency Builders:

Plan physical layout and work flow
 Illustrate business or job procedures/operations using flowcharts
 Prioritize work
 Establish/maintain operating policies and procedures
 Establish/maintain production standards
 Establish/maintain linkages with other departments
 Systematize work
 Delegate work
 Communicate operating policies and procedures, priorities, linkages, and standards to others
 Provide work assignments and instructions
 Monitor progress
 Solve work flow/operations problems using problem-solving, decision-making, and critical thinking strategies
 Prepare productivity reports
 Communicate contents of productivity reports to others in accordance with company procedures

BIL: Essential
AC:

EDU:	12	AD
	I	P

Competency 4.8: Maintain company security

Competency Builders:

Access needed information using company references
Plan security procedures in accordance with business ethics
Communicate security procedures internally
Ensure compliance with security procedures
Document security procedures
Perform security checks
Correct security problems

BIL: Essential
AC:

EDU:	12	AD
	I	P

Competency 4.9: Support the company's social and community involvement

Competency Builders:

Propose environmental, educational, and community needs and social issues on which to focus company support
Select issues on which to focus company support
Participate in social and/or community activities
Encourage staff involvement
Recognize the importance of the company's social and community relationships and their effects on the company

Unit 5: Customer Relations

BIL: Essential

AC:

EDU:	12	AD
	P	PR

Competency 5.1: Demonstrate positive relations with customers

Competency Builders:

Identify importance of customers to business

Differentiate between customer needs and wants

Comply with dispatch orders

Calculate job cost estimate

Provide prompt and courteous service

Resolve customer inquiries and complaints and/or refer customer to appropriate person

Identify methods of addressing dissatisfied customers

Make thoughtful commitments

Demonstrate proper phone etiquette

Write service report

BIL: Recommended

AC:

EDU:	12	AD
	IR	PR

Competency 5.2: Perform scheduling functions to meet customer's needs

Competency Builders:

Create calendar/schedule

Maintain appointment calendars

Process requests for appointments

Verify appointments

Notify customer of changes in schedule
Manage scheduling conflicts

Unit 6: Troubleshooting and Repair

BIL: Essential

AC:

EDU:	12	AD
	P	R

Competency 6.1: Demonstrate troubleshooting skills

Competency Builders:

Explain role of preventive maintenance

Differentiate normal and abnormal operations

Explain troubleshooting procedures

Explain logical actions taken to troubleshoot

Use proper troubleshooting aids

Demonstrate knowledge of safety rule for troubleshooting and repair procedures

Maintain troubleshooting and repair records

Use manufacturer's manuals, schematics, and troubleshooting charts

Isolate faults, shorts, and open circuits

BIL: Essential

AC:

EDU:	12	AD
	P	R

Competency 6.2: Apply troubleshooting techniques to DC circuits

Competency Builders:

Identify noise problems

Isolate faults in series, parallel and series parallel

Isolate faults in bridge circuits

Isolate faults in DC power supplies

Perform polarity check

Isolate faults to DC drive system

Isolate faults in voltage divider circuits
Repair faults

BIL: Essential
AC:

EDU:	12	AD
	I	P

Competency 6.3: Apply troubleshooting techniques in discrete solid-state devices

Competency Builders:

Isolate faults in diode circuits
Isolate faults in thyristor circuitry (e.g., SCR, TRIAC, DIAC)
Isolate faults in transistor circuits
Isolate faults in operational amplifier circuits
Isolate faults in single-stage amplifiers
Repair faults

BIL: Recommended
AC:

EDU:	12	AD
		I

Competency 6.4: Apply troubleshooting techniques to analog circuits

Competency Builders:

Isolate faults in single and multistage amplifiers
Isolate faults in audio power amplifiers
Isolate faults in regulated and switching power supply circuits
Isolate faults in active filter circuits
Isolate faults in oscillator circuits
Isolate faults in operational amplifier circuits

Isolate faults in power supplies (loaded and unloaded) and filters
Repair faults

BIL: Recommended
AC:

EDU:	12	AD
		I

Competency 6.5: Apply troubleshooting techniques to digital circuits

Competency Builders:

Identify noise problems
Isolate faults in multiplexer and demultiplexer circuits
Isolate faults in logic gates
Isolate faults in arithmetic-log circuits
Isolate faults in encoders and decoders
Isolate faults in digital-display devices
Repair faults

BIL: Essential
AC:

EDU:	12	AD
	I	P

Competency 6.6: Apply troubleshooting techniques to a microcomputer system

Competency Builders:

Isolate faults to systems boards
Isolate faults to memory circuits
Isolate faults to data storage devices
Isolate faults in power supplies
Troubleshoot I/O ports
Isolate faults in I/O interface circuitry
Use diagnostic software

Repair faults

Unit 7: Electrical Theory

BIL: Essential

AC:

EDU:	12	AD
	P	R

Competency 7.1: Explain basic electrical theory

Competency Builders:

Describe atomic structure and its relationship to electricity

Describe the relationship between electrical and magnetic properties

Describe the electrical and magnetic properties of a magnet

Describe the photoelectric effect

Describe the thermocouple effect

Describe the electrical effect of friction

Identify sources of electricity

Identify potential sources of electricity

Describe differences between AC/DC

Describe effects varying degrees of electricity have on the human body

BIL: Essential

AC:

EDU:	12	AD
	P	R

Competency 7.2: Explain operation of electrical distribution systems

Competency Builders:

Explain generation of electricity

Explain transmission of electricity

BIL: Essential
AC:

EDU:	12	AD
	P	R

Competency 7.3: Demonstrate proficiency in direct current (DC) circuits

Competency Builders:

Describe voltage, current, resistance, power, and energy

Solve algebraic problems to include exponential (prerequisite to DC)

Measure properties of a circuit using volt-ohm meter (VOM) and digital volt-ohm meter (DVM) meters and oscilloscopes

Apply Ohm's Law

Construct parallel circuits

Construct series circuits

Construct series parallel and bridge circuits

Define voltage divider circuits (loaded and unloaded)

Construct DC circuits that demonstrate the maximum power transfer theory

Solve problems in electrical units utilizing metric units

Describe the principles and operation of electrochemical supplies

Apply Kirchhoff's law

Interpret color codes and symbols to identify electrical components and values

Measure properties of a circuit using analog and digital meters and oscilloscopes

Measure conductance and resistance of conductors and insulators

Describe magnetic properties of circuits and devices

Describe the physical and electrical characteristics of capacitors and inductors

Describe RC and RL time constants

Set up power supplies for DC circuits

Operate power supplies for DC circuits

Analyze frequency spectrums

Apply Thevenin's and Norton's theorems

BIL: Essential
AC:

EDU:	12	AD
	IR	P

Competency 7.4: Demonstrate proficiency in alternating current (AC) circuits

Competency Builders:

Analyze AC signals utilizing VOM, DVM, oscilloscope, frequency counter, and function generator

Measure power in AC circuits

Analyze properties of an AC signal

Identify AC sources

Describe the principles and operation of the characteristics of capacitive circuits

Describe the principles and operation of the characteristics of inductive circuits

Demonstrate the operation of inductive circuits

Describe the principles and operation of the principles of transformers

Demonstrate the operation of AC circuits utilizing transformers

Describe basic motor theory and operation

Describe basic generator theory and operation

Operate power supplies for AC circuits

Describe the principles and operation of various power conditioning (e.g., isolation transformers, surge suppressors, uninterruptable power systems)

Describe the principles and operation of various safety grounding systems (e.g., lightning arresters, ground fault interrupters, etc.)

BIL: Essential
AC:

EDU:	12	AD
	IR	P

Competency 7.5: Demonstrate proficient use of electrical measurement equipment

Competency Builders:

Describe function and operation of analog volt-ohm-meter (AVM)

Describe function and operation of digital volt-ohm-meter (DVM)

Describe function and operation of amp probe

Describe function and operation of oscilloscopes

Describe function and operation of operation of infrared heat sensor

Apply measurement equipment to DC circuits

Apply measurement equipment to AC circuits

Apply measurement equipment to solid-state devices

Apply measurement equipment to digital circuits

Apply measurement equipment to analog circuits

Apply measurement equipment to microprocessors

Unit 8: Equipment Maintenance

BIL: Essential

AC:

EDU:	12	AD
	P	PR

Competency 8.1: Perform housekeeping

Competency Builders:

Dispose of scrap metal chips, shavings, trash and waste

Clean work area

Store hand tools, cutters, fixtures, jigs, and attachments

Store grinding wheels

Follow tool crib procedures

Inspect machine guards

Replace or adjust machine guards

Report problems to supervisor

BIL: Essential

AC:

EDU:	12	AD
	I	PR

Competency 8.2: Perform recordkeeping

Competency Builders:

Explain reasons for keeping maintenance records

Explain reasons for keeping cost records

Complete work order

Complete internal requisition

Complete external requisition

Complete time cards

Complete job status reports

Complete equipment failure reports

Record preventive maintenance activities
 Record repair activities
 Read job orders and process sheets
 Locate tooling and set up information
 File reports
 Prepare new/replacement equipment recommendations

BIL: Essential
AC:

EDU:	12	AD
	I	PR

Competency 8.3: Inspect machine systems

Competency Builders:

Explain planned maintenance
 Explain preventive maintenance measures (e.g., lubrication)
 Log machine histories
 Explain machine system(s) calibration
 Inspect linkages and lever mechanisms
 Inspect drive couplings
 Inspect clutches
 Inspect roller ball bearings
 Inspect safety systems
 Analyze system failure
 Make minor adjustments/repairs
 Coordinate maintenance services

BIL: Recommended

AC:

EDU:	12	AD
	I	I

Competency 8.4: Perform machine maintenance

Competency Builders:

Use operator's and manufacturer's manuals

Operate individual machines

Diagnose malfunctions

Apply lockout/tagout procedure

Disassemble defective section

Clean equipment

Lubricate equipment

Check equipment for wear and alignment

Repair or replace defective parts

Test machine for performance

Make minor adjustments to equipment

Prepare planned maintenance schedules

Explain breakdown maintenance

BIL: Essential

AC:

EDU:	12	AD
	P	R

Competency 8.5: Operate hand tools

Competency Builders:

Demonstrate use and care of measuring devices (e.g., rules, tapes, calipers, micrometers, multimeter, thermometer, and coordinate measuring system)

Demonstrate use and care of common hand tools

Demonstrate proper metal working bench skills (including use of vices, hacksaws, files, tapes, dies, and reamers)

Demonstrate use and care of pipe clearing equipment

BIL: Essential

AC:

EDU:	12	AD
	P	R

Competency 8.6: Operate portable power tools

Competency Builders:

Demonstrate use and care of light-duty and heavy-duty drills

Demonstrate use and care of electric hammers

Demonstrate use and care of pneumatic drills and hammers

Demonstrate use and care of power screwdrivers and impact wrenches

Demonstrate use and care of belt, pad, and disc sanders

Demonstrate use and care of grinders

Demonstrate use and care of lifts

BIL: Essential

AC:

EDU:	12	AD
	P	R

Competency 8.7: Operate stationary equipment

Competency Builders:

Demonstrate use and care of mechanical presses

Demonstrate use and care of hydraulic presses

Demonstrate use and care of drill presses

Demonstrate use and care of bench grinders

Demonstrate use and care of power saws (e.g., hack, cut-off, chop, band, jig, and table)

Unit 9: Mechanical Power Distribution

BIL: Essential

AC:

EDU:	12	AD
	IR	PR

Competency 9.1: Demonstrate knowledge of basic mechanics

Competency Builders:

Explain working forces of torque, tension, and compression

Explain the laws of motion

Explain how to calculate work in several ways

Explain the function of simple machines including levers, inclined plane, wedge
wheel and axle, pulley and screw, gears

Explain the types of power and the method of producing power

Explain the laws of friction

Explain mechanical efficiency

Apply basic knowledge of physics

Calculate speed changes

BIL: Essential

AC:

EDU:	12	AD
	I	P

Competency 9.2: Describe mechanical power distribution systems

Competency Builders:

Describe the principles and operation of compound and reverted gear trains

Describe the principles and operation of internal and planetary gear trains

Describe the principles and operation of helical and bevel gear trains

Describe the principles and operation of rack and pinion, worm and wheel, and
block and screw mechanisms

Describe the principles and operation of counter rotating mechanisms and differentials

Describe the principles and operation of spring mechanisms, pulley blocks, and differentials

Describe the principles and operation of chain, belt and disc drives and universal joints

Describe the principles and operation of clutch and coupling mechanisms

Describe the principles and operation of braking mechanisms

Describe the necessity for proper alignment and fit of mechanical devices

Describe the necessity for proper balance of system components

Describe proper component matching (e.g., sheave sets, gear sets)

BIL: Essential
AC:

EDU:	12	AD
	P	PR

Competency 9.3: Use bearings

Competency Builders:

Define bearing

Define bearing theory

Define bearing purpose

Identify types of bearings and their applications

Identify installation method

Install bearings

Maintain bearings (e.g., lubrication)

Remove bearings

Identify bearing failure modes

BIL: Essential

AC:

EDU:	12	AD
	P	PR

Competency 9.4: Use seals

Competency Builders:

Define seal

Define seal theory

Define seal purpose

Identify types of seals and their applications

Identify installation method

Install seals

Maintain seals

Remove seals

Identify failure modes

BIL: Essential

AC:

EDU:	12	AD
	IR	PR

Competency 9.5: Use gears

Competency Builders:

Define gears

Define gear theory

Define gear purpose

Explain impact of electronic systems on gears

Identify types of gears, their materials, and their applications

Identify installation method

Install gears

Maintain gears (e.g., lubrication)

Remove gears
Identify failure modes

BIL: Essential
AC:

EDU:	12	AD
	P	PR

Competency 9.6: Use belts and pulleys

Competency Builders:

Define belts and pulleys
Define belt and pulley theory
Define belt and pulley purpose
Explain impact of electronic systems on belts and pulleys
Identify types of belts and pulleys and their applications
Identify installation method
Install belts and pulleys
Maintain belts and pulleys
Remove belts and pulleys
Identify failure modes

BIL: Essential
AC:

EDU:	12	AD
	P	PR

Competency 9.7: Use sprockets and chains

Competency Builders:

Define sprockets and chains
Define sprocket and chain theory
Define sprocket and chain purpose
Explain impact of electronic systems on sprockets and chains

Identify types of sprockets and chains and their applications
 Identify installation method
 Install sprockets and chains
 Maintain sprockets and chains
 Remove sprockets and chains
 Identify failure modes

BIL: Essential
AC:

EDU:	12	AD
	IR	PR

Competency 9.8: Use cams and levers

Competency Builders:

Define cams and levers
 Define cam and lever theory
 Define cam and lever purpose
 Explain impact of electronic systems on cams and levers
 Identify types of cams and levers and their applications
 Identify installation method
 Install cams and levers
 Maintain cams and levers
 Remove cams and levers
 Identify failure modes

BIL: Essential
AC:

EDU:	12	AD
	IR	PR

Competency 9.9: Use clutches and brakes

Competency Builders:

Define clutches and brakes

Define clutch and brake theory

Define clutch and brake purpose

Explain impact of electronic systems on clutches and brakes

Identify types of clutches and brakes and their applications

Identify installation

Install clutches and brakes

Maintain clutches and brakes

Remove clutches and brakes

Identify failure modes

BIL: Essential
AC:

EDU:	12	AD
	I	P

Competency 9.10: Install drive components

Competency Builders:

Identify types of couplings and their applications

Define drive component theory

Install solid coupling

Install jaw coupling

Install molded rubber coupling

Install chain type coupling

Align bearings, bushing, and cams

Install belts and adjust tensions

Explain the purposes and advantages of a chain drive system in relation to a belt drive system
 Explain the function of speed reducers
 Explain the function of gears and variable speed reducers
 Install shafts
 Align shafts
 Mount drive sprockets and chains
 Mount gears on open gear drives
 Align gears on open gear drives
 Install a mechanical clutch system
 Install adjustable speed drives
 Troubleshoot adjustable speed drives
 Explain the operation of fluid couplings/torque converters
 Install torque converters
 Perform preventive maintenance on drive components
 Inspect completed work
 Describe types of fit and tolerances
 Explain importance of balance
 Explain impact of electrical systems on drive components

BIL: Essential
AC:

EDU:	12	AD
	IR	PR

Competency 9.11: Demonstrate knowledge of levers, linkages, and mechanisms

Competency Builders:

Describe class one, two, three, and compound levers
 Describe the principles and operation of rocker arm and bell crank linkages and combined mechanisms
 Describe the principles and operation of drag link and intermediate mechanisms
 Describe the principles and operation of cam mechanisms
 Describe the principles and operation of pivoted follower mechanisms
 Describe the principles and operation of toggle, quick return, and ratchet mechanisms
 Explain impact of electronic systems on mechanisms, linkages, and levers

BIL: Essential

AC:

EDU:	12	AD
	IR	PR

Competency 9.12: Apply knowledge of lubricants

Competency Builders:

Explain the function of lubricants

Explain lubricant and friction theory

Explain purpose of lubricants

Explain the properties of oil lubricants and factors determining the selection of lubricants

Identify types and functions of lubricant additives

Describe types of circulating oils and their purposes

Describe lubricating systems, including the charts and methods used

Demonstrate proper grease application

Demonstrate proper grease application

Demonstrate proper lubricant storage and handling

Lubricate a piece of industrial equipment

Identify specified lubricant or equivalent

Identify specified lubricant or equivalent

Explain lubricant recovery and disposal

Explain use of oil analysis reports

Unit 10: Hydraulics and Pneumatics

BIL: Essential

AC:

EDU:	12	AD
	I	P

Competency 10.1: Describe fluid concepts

Competency Builders:

Explain Pascal's Law

Explain Boyle's Law

Explain Bernoulli's Law

Describe flow velocity

Explain how heat and pressure relate to power and transmission

Describe physical properties of a fluid

Describe fluids in motion in closed conductors

Describe continuity of mass flow

Identify types of fluids

Identify properties of fluids

Identify English and metric units of measurement for pressure, density, and viscosity

Explain impact of electronic systems on pneumatic systems

BIL: Essential

AC:

EDU:	12	AD
	I	P

Competency 10.2: Describe energy conservation

Competency Builders:

Differentiate work and power

Differentiate potential and kinetic energy

Explain energy conservation concept

Explain hydraulic horsepower
Explain work of compression in compressible fluids

BIL: Essential
AC:

EDU:	12	AD
	I	P

Competency 10.3: Describe system losses

Competency Builders:

Differentiate turbulent and laminar flow

Explain friction factor

Explain pressure losses

Identify potential system losses (e.g., leaks, wear, component sizing, heat, dirt)

BIL: Essential
AC:

EDU:	12	AD
	I	P

Competency 10.4: Describe hydrostatics

Competency Builders:

Explain pressure, density, and viscosity

Explain buoyancy

Explain equilibrium

BIL: Essential
AC:

EDU:	12	AD
	I	P

Competency 10.5: Calculate energy

Competency Builders:

Apply Pascal's Law

Apply Bernoulli's Principle

Apply Boyle's Law

Calculate work and power

Calculate potential and kinetic energy

Calculate hydraulic horsepower

Calculate flow velocity and pressure

Calculate pressure losses

Calculate laminar flow

Calculate pump capacity

Calculate systems requirements

BIL: Essential

AC:

EDU:	12	AD
	IR	PR

Competency 10.6: Describe component system

Competency Builders:

Use common symbols

Create circuit diagrams (i.e., schematics)

Diagram closed-loop hydraulic system

Diagram an air supply system

BIL: Essential
AC:

EDU:	12	AD
	IR	PR

Competency 10.7: Describe component operation

Competency Builders:

Identify functions and operation of hydraulic components

Identify functions and operation of phenmatic components

Explain application(s) of different materials

BIL: Essential
AC:

EDU:	12	AD
	IR	PR

Competency 10.8: Interpret hydraulic and pneumatic schematics

Competency Builders:

Identify common symbols

Sketch circuit diagrams (i.e., schematics)

Interpret circuit analysis

Sketch circuit analysis

Diagram an air supply system

BIL: Essential

AC:

EDU:	12	AD
	IR	PR

Competency 10.9: Troubleshoot hydraulic and pneumatic circuits

Competency Builders:

Analyze hydraulic circuits

Troubleshoot hydraulic circuits

Analyze pneumatic circuits

Troubleshoot pneumatic circuits

BIL: Essential

AC:

EDU:	12	AD
	IR	PR

Competency 10.10: Perform pump maintenance and repair

Competency Builders:

Identify types and operating features of pumps

Identify pump capacity and system requirements

Explain packing and seal requirements

Explain operating principles of pumps (e.g., centrifugal, propeller and turbine rotary, metering)

Perform pump maintenance

Disassemble a pump

Reassemble a pump

BIL: Essential
AC:

EDU:	12	AD
	IR	PR

Competency 10.11: Maintain piping and accessories for high and low pressure fluid power systems

Competency Builders:

Identify components of a piping system

Explain maintenance features of both metallic and non-metallic piping systems

Explain types of valves and their operation and maintenance

Explain use of maintenance of strainers, filters, and traps in piping systems

Join common fittings

Join metallic pipe

BIL: Essential
AC:

EDU:	12	AD
	IR	PR

Competency 10.12: Troubleshoot hydraulic systems

Competency Builders:

Interpret hydraulic schematic

Identify causes of failure modes

Connect electrically controlled valves

Explain hydraulic system troubleshooting techniques

Repair or replace hydraulic valves

Repair or replace hydraulic cylinders

Repair or replace hydraulic pumps and motors

Install hydraulic components

BIL: Essential
AC:

EDU:	12	AD
	IR	PR

Competency 10.13: Maintain vacuum systems

Competency Builders:

Describe characteristics associated with vacuum systems and sub-atmospheric pressure

Describe the principles and operation of vacuum gauges

Demonstrate use of vacuum gauges

Repair or replace vacuum gauges

Describe the principles and operation of vacuum pumps

Demonstrate use of vacuum pumps

Repair or replace vacuum pumps

Describe the principles and operation of vacuum controls

Demonstrate use of vacuum controls

Repair or replace vacuum controls

Describe effect of electronic system on vacuum system

Explain impact of electronic systems on vacuum systems

Unit 11: Basic Materials Science

BIL: Recommended

AC:

EDU:	12	AD
	I	R

Competency 11.1: Demonstrate basic knowledge of metallurgy

Competency Builders:

Define metallurgy

Define metal forming (e.g., general process)

Identify forming industries (e.g., stamping, forging, fabricating)

Describe metal forming principles

Describe the metal forming process

Identify frequently used metals

List physical properties of common metals

Describe measures of metal strength

Identify examples of raw materials processed by hot rolling, cold rolling, forging, drawing, extrusion, spinning and powdered metallurgy

Explain secondary finishing operations (e.g., paint, anodizing)

BIL: Recommended

AC:

EDU:	12	AD
	I	R

Competency 11.2: Demonstrate basic knowledge of metal characteristics and formability

Competency Builders:

Explain metal grades and coatings

Explain tensile test

Explain surface test

Describe process of heat treating

Define types of heat treating (e.g., case hardening, annealing, drawing, stress relieving, tempering, quenching, critical temperature)

BIL: Recommended

AC:

EDU:	12	AD
	I	R

Competency 11.3: Demonstrate basic knowledge of casting

Competency Builders:

Identify frequently used metals

List physical properties of common metals

Define permanent mold casting

Define shell mold casting

Define sand casting and pattern making

Define die casting

Identify basic casting materials

Identify advantages/disadvantages of casting processes

BIL: Recommended

AC:

EDU:	12	AD
	I	R

Competency 11.4: Demonstrate knowledge of corrosion and protection

Competency Builders:

Identify causes of corrosion

Identify types of corrosion

List solutions to minimize problems

Identify corrosion testing

BIL: Recommended

AC:

EDU:	12	AD
	I	R

Competency 11.5: Demonstrate basic knowledge of rubber manufacturing

Competency Builders:

Compare properties of natural rubber with those of synthetic rubber

Explain vulcanization, mastication, and cure systems

Explain how synthetic rubber is manufactured (e.g., neoprene, butyl, styrene-butadiene)



U.S. Department of Education
Office of Educational Research and Improvement (OERI)
National Library of Education (NLE)
Educational Resources Information Center (ERIC)



NOTICE

Reproduction Basis

X

This document is covered by a signed "Reproduction Release (Blanket)" form (on file within the ERIC system), encompassing all or classes of documents from its source organization and, therefore, does not require a "Specific Document" Release form.



This document is Federally-funded, or carries its own permission to reproduce, or is otherwise in the public domain and, therefore, may be reproduced by ERIC without a signed Reproduction Release form (either "Specific Document" or "Blanket").